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A Desirable Revival

We constantly receive requests for technical advice accompanied by a minimum of information as to current operating conditions. Surely it is obvious, that before changing a process or buying new equipment, the management should know exactly what they are doing. During the war, the Government went to considerable trouble to popularize statistical control. Many firms made a promising start, some have continued and have derived considerable benefit from it, but others have discarded this useful task. One would judge from a précis of a paper by Mr. Drachman printed in *Gjuteriet* that he can forecast the probability of complaints from the machine-shop from a statistical study of the carbon-equivalents of the iron castings he manufactures. Such knowledge will quickly recover the cost of obtaining and graphing the daily figures.

One of the factors which has allowed statistical control to lapse is the incidence of summer holidays. Only too frequently, it happens that the man who undertakes this duty has no one to whom he can delegate his work during his absence, and consequently he and everybody else loses interest in the subject, when there is a break in continuity. Yet for the financial control of a concern, the work of a cost clerk is invariably continuous despite vacations. It is not intelligent management, to ascertain in detail the cost of each item of production and yet to neglect the equally important aspect of quality control.

What should be controlled is a matter for the management, just as is the extent to which the costing is detailed. The minimum we suggest are the properties of the raw materials; sand, and metal control. Presuming the availability of a laboratory, the work of the routine chemist can be made so much more interesting if there be added to his duties, the work of statistical control. Everybody can be made alive to the significance of the control curves, rather than interminable arguments as to the meaning of isolated abnormalities, especially when the normal is not too well established. Never in the history of industrial development was statistical control more necessary than to-day. Gone are the days when Jones' pig-iron and Smith's coke could be relied upon never to vary from the high standard their reputation had established. Equally, one can no longer pick and choose as to which is and which is not desirable scrap. Whilst inquests sometimes create wide interest amongst the staff, often the evidence is incomplete and sometimes unreliable. Surely it is preferable, to institute a control, so that their occurrence becomes increasingly infrequent. After all, sound financial control is best insurance against an inquest in Carey Street.

Use of Statistics

Mr. Jörgen Drachman has summarized a Paper presented in *Gjuteriet* on the correlation between analysis and certain mechanical properties in ordinary grey cast iron in the following statement:—

This investigation was undertaken to show that it is possible to obtain results of a certain scientific and practical value without expensive instruments and laboratory equipment by using daily test results and treating them statistically. As an example, the author has chosen the influence of carbon, silicon, manganese and sulphur on machinability, Brinell hardness and chill depth in ordinary grey cast iron with a phosphorus content of approximately 0.60 per cent. The author has used both linear and quadratic approximations. The results show that variations of machinability and Brinell hardness with the carbon and silicon content of the iron are equally well described as variations of these properties with the carbon equivalent. For machinability this is true at least by linear approximation. The chill depth, on the other hand, has a minimum at 2.70 per cent. Si. The manganese/sulphur ratio has a great influence on machinability. It cannot be statistically combined with C and Si in one equation and therefore it is treated separately. The author ends by expressing his regret that so few foundrymen are interested in statistical research, as many valuable test results are thereby left unused.

Cement Moulding

The July issue of *Fonderie* in its section "Practical Advice to Founders," suggests the following composition as suitable for cement moulding:—

Silica sand	...	90 to 92 parts (by weight)
Cement	...	8 to 10 " "
Water	...	8 to 10 " "

The sand used should be clay-free and contain 97, if not 98, per cent. of silica. Its A.F.S. fineness number should be of the order of 50 to 65. New sand is used as facing sand, but the backing is reconditioned old sand made up with 4 per cent. cement. Ordinary turn-over moulding machines can be used, but care is needed not to give too many jars as the ramming should not be very hard. Where moulds have to be turned over to withdraw the pattern, there is no need to use hooks or the like, as they are quite useless. If surface treatment be given to the mould, it is suggested that before casting up, it should be warmed up not more than 140 deg. C. and a charcoal fire is mentioned.

I.B.F. Golf Meeting

Woodhall Spa, September 27 and 28

Intending competitors in the golf meeting of the Institute of British Foundrymen are reminded that entries close on August 31, and should be sent in without delay to the Hon. Secretary, Mr. F. Arnold Wilson, c/o William Jacks & Company, Limited, Winchester House, Old Broad Street, London, E.C.2. The entries already received number 37 players and 22 spectators, a total of 59. There are still a few rooms available at the Golf Hotel, Woodhall Spa, where the party are staying.

THE SWEDISH FOUNDRY OWNERS' FEDERATION is holding a technical congress at Orebro from August 31 to September 1. The works of A. B. Johnson Werken; Avos and Svenska Skifferolje A.B.; Kvarntorp, are to be visited.

Conference Paper Authors

MR. J. RICHARDSON, who is co-author with Mr. C. F. Lawson of the paper "Methods Employed in the Production of Heavy Iron Castings," (printed on the adjoining pages), was educated at Norton Lees School, Sheffield, Sheffield Technical College and Sheffield University. He served his apprenticeship with the Brightside Foundry and Engineering Company, Limited, and in 1930 was appointed assistant to the foundry superintendent of this Company. In 1932 he was promoted to the post of foreman patternmaker and subsequently he became clerk of works and then assistant foundry manager. In 1947 he was appointed to his present post of foundry manager. Mr. Richardson is a member of the Council of the Sheffield Trades Technical Society. He is also a member of the Iron and Steel Institute and of the Sheffield Society of Engineers and Metallurgists.

MR. C. F. LAWSON is joint author with Mr. J. Richardson of the paper "Methods Employed in the Production of Heavy Iron Castings." Mr. Lawson, who was born in 1918, was educated at Owler Lane School and Sheffield Central Technical College. Later he studied Mechanical Engineering and Metallurgy at Sheffield University. After serving his apprenticeship with the Brightside Foundry and Engineering Company, Limited, Mr. Lawson was appointed assistant to the foundry manager. In May, 1947, he became foundry manager of Buckley & Taylor, Limited, of Oldham, a position which he still holds. Mr. Lawson is an Associate of the British Institute of Management and a member of the Manchester branch of the Institute of Industrial Administration. In 1937 he was a Buchanan prize winner in the City and Guilds of London Institute examination in foundry practice. Mr. Lawson served for six years with the York and Lancaster Regiment during the recent war and held the rank of Captain.

Latest Foundry Statistics

According to the June bulletin of the British Iron and Steel Federation the average weekly employment in the ironfoundry industry during May increased by 286 to 155,910 as compared with a month earlier, representing a gain on the year of 4,367. Steel for steel castings showed an improvement on the weekly average during May at 11,300 tons against 9,200 tons a year ago.

The British Bureau of Non-ferrous Metal Statistics report in their June Bulletin that the output of copper alloyed castings during that month was 4,695 tons. The production for the first six months of this year was 35,382 tons as against 31,300 tons in 1951.

Methods Employed in the Production of Heavy Iron Castings*

By J. Richardson and C. F. Lawson

The Authors, on being requested to write a paper which would be of particular interest to practical foundrymen, considered that the most useful paper must be of general interest and of wide appeal and yet related to and contain illustrations of specific jobs. To write about a specific job in detail would perhaps interest only a few members and, alternatively, to write about a particular aspect of ironfounding would be somewhat removed from the everyday "line of thought" of the practical man. With this in mind, the Authors decided to approach the subject through the "line of thought" of the practical man and yet—bearing in mind the objects of the Institute—to introduce the "scientific approach" with a view to assisting in creating a better understanding between the practical craftsman and the technical practical man. Since the contents of a single paper must of necessity be limited, it was therefore decided that the Paper would be in the form of a general introduction and if it was found to create reasonable interest would be followed later by a series of more detailed papers on specific aspects of their job. Reference is made to the practical application of some recent reports and findings of the Institute's technical committees. In conclusion, the Paper exemplifies the advantages to be gained by the fusion of pure science, organization and craftsmanship through experience.

In the manufacture of steelworks plant and equipment for rolling mill and forge, the range of castings required can truly be said to call for almost every known method employed in foundry practice. A few examples of heavy castings are presented and particular reference made to their main features and problems. Production methods are analysed with the object of extracting the main principles from the mass of routine detail and formulating general principles applicable to a variety of castings.

Introduction

With few exceptions, the Authors feel that it would be true to say that the practical foundryman's direct interest in other foundries is "What are they making; have they anything similar to a job of mine and if so how is it made?" On looking round he finds the same job being made in a number of apparently different ways. Further, he finds that the other fellow is using a method which he found to be disastrous in consequences, and conversely the other fellow claims disastrous consequences when using an alternative method, and so on. The conclusion he tends to draw, in his frustration, is that the whole thing does not make sense and "It is all a matter of luck."

This state of mind arises out of lack of knowledge of the principles underlying many of the complex phenomena occurring in the foundryman's everyday work. The only luck really required is in an ability to see where and what principles are involved and in developing the means to apply them with reasonable control. Where two jobs are made successfully by *apparently* different methods the Authors suggest that the main principles have been observed and it is merely the "trimmings" that are different. The task then is to subject the methods used to closer observation and honest analysis, determine the main principles involved, evolve means for their measurement and control and then to apply personal knowledge along with commonsense. In short the main principles must be observed; whereas the "trimmings" may be left to the convenience of the particular facilities available for use; *e.g.*, the purely practical consideration of producing a sound casting is not dependent on whether the job is bedded-in the foundry floor or made in moulding boxes. It could be made in dry-sand, loam, rammed by hand, pneumatic rammer, jolt-rammed or rammed by Sandslinger. The facilities available decide the method of construction but definite principles decide the fundamentals such as method of gating, feeding arrangements and type of metal to be used.

Honest Analysis

When foundry problems arise (and usually they are in the form of unsatisfactory castings), emotional stress is apt to preclude sound judgment; it is therefore very helpful to be able to approach the problem systematically, and by factual elimination to narrow down the field of possibilities. Naturally, all concerned will have many suggestions which surprisingly nearly always arise out of "the other fellow's" part or operations in the job.

At this stage honest analysis poses the following:—(*a*) Is one looking for the reasons for the failure and thereby the means to future success, or (*b*) is one merely looking for someone to blame? Depending on the answer to this first question, will be the success of further enquiry and analysis.

Human Failures and Principles

Where the foundryman knows, after deliberation, that the reasons indicate the blame is his own, he can quite easily "blind 'em with science" and, using his superior rank, pass the blame to a subordinate. This attitude (and where are the innocents?) is really stupid, as failure to admit the true state of affairs is only piling-up further trouble. Where the real reasons remain obscure, it is also

* Paper presented to the Buxton Conference of the Institute of British Foundrymen.

FIG. 1.—*Typical Finished 3-high Roll Housing Stands, the Castings for which are Described.*

possible but inadvisable, for sake of prestige, to invent plausible reasons. In these cases, honest analysis does not exist. Where no certain conclusions can be reached it is better to record *reasons in doubt* and call for assistance and a second opinion.

The Authors will next present, first, a brief method of general analysis of foundry factors as an example of the analytical approach to general principles and problems and, secondly, a series of examples of heavy iron castings showing the method of manufacture and main features. As far as possible the examples are placed in one of six groups, depending on the type of main feature.

General Foundry Factors

Almost any foundry subject or activity can be placed in one of the following categories:—

(1) Organization and administration, planning and control.

(2) Layout and equipment.

(3) Mould and core materials, preparation and control.

(4) Metallurgy, melting, materials and control.

(5) Training, welfare and control of operatives and staff.

With suitable sub-headings in each category the field can be widened until more-detailed activities are considered and a complete *aide-mémoire* is developed as an aid to clear thinking. The Authors find this method exceptionally useful in carrying out routine inspection into the general conduct of affairs.

Analysis of Production Factors

Production factors can be subdivided into

(1) Craft operations subject to standard methods: for example, mould construction; core-making and supporting, and venting of cores and moulds and the like.

(Again, the list can be enlarged and a clear picture obtained of the operations and factors for which the craftsman or operator is primarily responsible, without the issue of specific instructions.)

(2) Factors involving physical and chemical laws and requiring technical control, such as—mould and core materials; metallurgy; gating and feeding, and solidification and cooling phenomena.

These factors require almost the direct attention of the management and technical staff. The principles involved and decisions made are the direct responsibility, in most cases, of the foundry manager—the operator or craftsman working strictly to his instructions (a small point which is, however, often misinterpreted).

General Steelworks Castings

Figs. 1 to 4 show arrangements of modern steelworks equipment and illustrate the wide range of castings required; the equipment is "tailor made," being designed to order and executed completely within the organization with which the Authors are associated. Production of castings therefore rarely becomes repetitive and can be classified as "jobbing, general engineering." Many foundry orders are "one off only" with a remote possibility of a repeat order two to ten years hence; the cost of patternmaking is thus a major consideration in determining the method of construction of the mould. However, over a number of years, patterns have been constructed which, with modification and a little ingenuity in "stopping off" and "drawing to length," can be used for a range of similar castings. The very nature of this arrangement compels the foundry to use, in many cases, patterns which by *production* standards can only be

FIG. 2.—*Table for Live Rollers for a 28-in. Reversing Roughing Mill, Table Frames of Continuous Design.*

described as *rough*. Because of this, the final finish and definition of detail on the casting is a direct function of the skill of the moulders employed, who must of necessity possess "know-how." Fortunately, certain types of equipment call for a reasonable quantity of identical castings in the 2- to 10-cwt. category for which high-production methods can be employed and use made of less-skilled operatives.

Despite all possible simplification, the Authors have not yet found any method of using non-skilled operatives successfully on "jobbing work" but by control of materials and application of certain principles they have considerably reduced many hazards which previously were regarded as part of the moulder's skill.

Roll-housing Castings

Fig. 5 shows a typical roll housing stand for a 21-in. mill in the finished stage, weighing approximately 17 tons and Fig. 6 shows housing pattern for 40-in. mill, the finished casting weighing approximately 31 tons. The pattern for this job can be modified for similar castings.

Mould Construction.—The pattern is bedded in a pit 18 ft. by 13 ft. by 3 ft. 6 in. rammed-up and the joint line made at the top of the feet. The top face is jointed down to and carried by "gaggering" on the 18 ft. by 13 ft. by 18 in. top part. Mould drying is carried out by a coke-fired portable hot-air drying unit, and the top part is dried in a stove. Notwithstanding the simplicity of construction, the production of a sound casting presents many problems and involves two main principles. The first is fairly obvious from the massive nature of the casting—due to the extremely heavy section, the mould material (*i.e.*, facing sand) used is subjected to the severest conditions and, furthermore, the metal is likely to remain liquid in the mould for a considerable time. The second is equally as obvious yet more insidious, namely, the control of solidification and shrinkage by suitable feeding and densening methods. For this purpose, then, the positioning and proportions of the "runner" systems, local

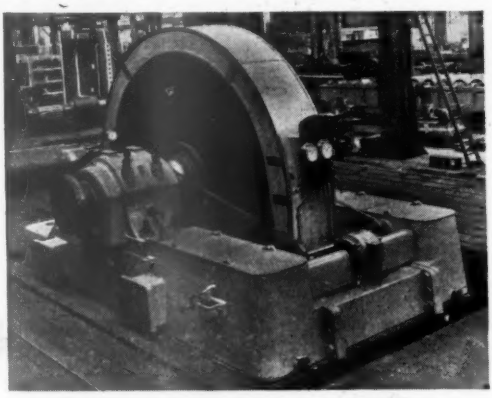


FIG. 3.—34-*ton Flywheel Set for Motor-generator Equipment.*

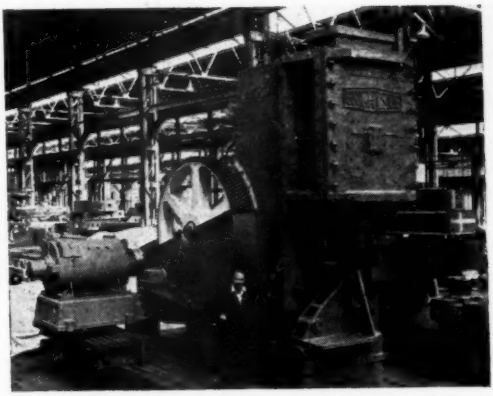


FIG. 4.—350-*ton Power Down/up Shear for Cutting Hot Bloom Shear for 7-in. sq. Blooms.*

densening and liquid shrinkage, and feeding arrangements are of prime importance and become the main features on this type of casting. It is proposed to give briefly a summary of the principles involved:—

Facing Sand for Heavy Castings

Satisfactory sand technique for heavy castings can be viewed as: (1) Correct blending of materials to give satisfactory characteristics and the required results, and (2) sand testing and control to ensure condition (1) is uniformly and consistently maintained.

Condition (1) is arrived at partly by laboratory research but mainly by observation of the finished castings and shop experience. Condition (2) is a means to an end and not an entirety. By this, the Authors imply that the introduction of a sand laboratory and sand control does not in itself guarantee good results, unless the correct technique has first been established. Once the technique is established sand testing is the only means of measurement of the sand characteristics with a sufficiency of accuracy and present a means to further development. Routine sand tests comprise: (*a*) green strength and permeability; (*b*) dry strength and permeability; and (*c*) percentage moisture determinations.

These are the common tests which are used almost universally and values are quoted for them when referring to sand technique. However, the Authors feel that they by no means tell the whole story and are of little value unless other lesser-known characteristics are taken care of. A few of such characteristics, now more widely appreciated, are:—(1) The rate and volume of gas evolution; (2) thermal expansion as related to the spalling of mould materials; (3) chemical reactivity of mould materials at elevated temperatures; and (4) gas absorption from mould materials into the metal.

Sand or Mould-face Stability

For want of a better word, the Authors describe

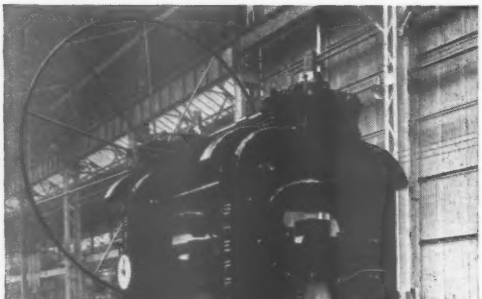


FIG. 5.—*Finished Roll-housing Stand for a* 21-*in. Mill, weight approximately* 17 *tons.*

as *stability* that property of a mould to withstand internal expansion when subjected to thermal shock. It is now known that many defects are due to expansion of the sand grains and the consequential buckling of the mould face. Examples are hollow scab, rat-tail scab, " roques," top pull-in (a misnomer) and penetration of metal into the sand after the face and coating wash has been destroyed by a buckle.

In the British Cast Iron Research Association's report No. 274, W. B. Parkes[1] admirably sums up the factors leading up to this type of defect and is worthy of repeated study; it confirms the theories held by the Authors for some years. The expansion of quartz grains when heated follows the normal laws of expansion (as in a steel railway line), but around 573 deg. C. there is a marked expansion when α quartz changes to β quartz followed by a slight contraction. This is shown in a graph prepared by Sosman[2] and reproduced in Fig. 7.

Control of Thermal Expansion Defects

The control of thermal expansion to avoid mould-face buckling and spalling appears to follow three factors:—(1) The use of materials of low expansion; (2) the use of materials of a wide grain-size distribution; and (3) the use of expansion suppressing agents. The implementation of (1) is limited by cost; moreover the second measure is easily possible but permeability is reduced. Since most of the defects due to expansion were previously attributed to low permeability, the line of thought can be altered and permeability now related to the rate of gas evolution, which means that, when using inert sands, the permeability may be reduced without ill effects.

Factor No. 3 implies the introduction to the sand mixture of a material which will:—(*a*) Prevent close packing of the grains; (*b*) create cushions or expansion gaps between the grains which will absorb grain expansion without causing mould-face defects, hence the analogy of the gap between railway lines; and (*c*) make the mould face thermoplastic and capable of yielding to expansional stresses.

In the light of this theory the use of " horse manure " can be regarded as " highly scientific " and " tops " are no longer " pulled in " but " fall in."

Facing Sand for a 40-in. Roll Housing

The sand used for the 40-in. roll housing was not built up on the principles enunciated but by " rule of thumb." However, on investigation it proves to be in line with the principles and is made up of:—

216 lb.	Bawtry Sand	Coarse grain.
108 lb.	Worksop Red Sand ...	Coarse to medium grain distribution.
108 lb.	" Compo "	Coarse grain and low thermal expansion.
10 lb.	Clay Bond	Prevents dense grain packing.
230 lb.	Reclaimed Sand (de-silted)	Medium to low thermal expansion and fine, clean grain-size.
Moisture		6 to 7 per cent.
Green-compression strength ...		4 to 5 lb. per sq. in.
Green permeability ...		over 90 A.F.S.
Dry-compression strength ...		87 lb. per sq. in.
Dry permeability		over 90 A.F.S.

In a subsidiary foundry, producing similar castings not exceeding 20 tons, equally good results are now achieved using:—

150 lb.	Manchester Weaste Sand	Coarse grain.
144 lb.	" Compo "	Low thermal expansion.
378 lb.	Return Sand (untreated)	Poor characteristics.
7 lb.	Pitch (proprietary) ...	Confers thermal plasticity.
4 lb.	Cotton shoddy	For expansion gaps.
Moisture		6 to 7 per cent.
Green-compression strength ...		6 to 8 lb.
Green permeability		25 to 30 A.F.S.
Dry compression		over 90 lb. per sq. in.
Dry permeability		45 to 50 A.F.S.

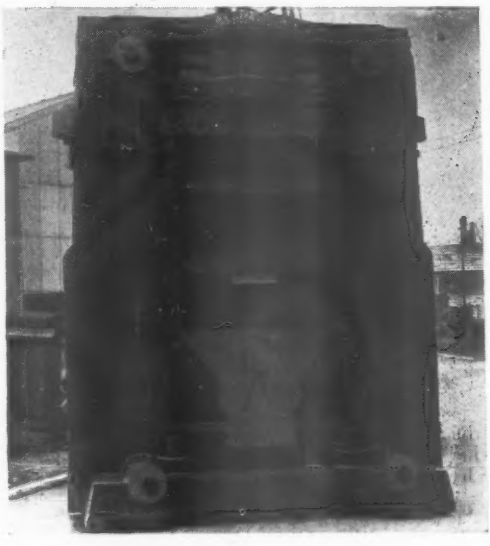


FIG. 6.—*Housing Pattern for a* 40-*in. Mill, the Finished Casting weighed approximately* 31 *tons.*

These mixtures appear very different and yet produce good results, the reasons being that in the first foundry, due to de-silting of the reclaimed sand, a very wide spread of grain sizes is possible and yet there is maintained a high permeability. The returned sand is clean and very fine. The new materials are mainly coarse grained and the resultant mixture becomes *stable* because of the ruling of Factor No. 2. In the second case, no de-silting plant is yet installed and the return sand contains considerable " fines "; however, by adding a coarse-grained material, " Compo," and a medium sand (Manchester Weaste sand) a reasonable permeability is created, but organic material and pitch are needed to make the mixture *stable* as the grain distribution is not spread sufficiently. Otherwise very bad defects from expansion would arise, hence the use of Factor No. 3.

No face sprigging whatsoever of the mould is necessary to prevent " scabbing," etc. The few sprigs used are merely for reinforcement of corners and the like. Naturally, if the moulds are not filled quickly the top part is subjected to considerable " *glare* " from the rising metal and may prematurely collapse either due to buckling or to the top sand becoming burnt. The speed of running therefore has a bearing on sand defects. The allowance of a minimum of 1.75 sq. in. of runner per ton of metal in the job has been found to be highly satisfactory on massive castings of this type.

Feeding and Control of Solidification in Heavy Castings

In iron castings, generally, the liquid metal shrinkage before and during solidification must be made good unless cavities are to arise. Defects and types of shrinkage can be classified as:—

(*a*) *Micro-porosity* in which the cavities are widely dispersed and intercrystalline (open-grain metal).

(*b*) *Macro-porosity* in which the cavities are localized in the areas last to solidify (common " draw " or " shrinkage pipe "); the metal generally being close grained.

(*c*) *Segregation* of the phosphide eutectic constituent, in which the constituent having a low freezing point (930 deg. C.) acts as a first-class " feed iron " and drains from " hot spots " to make good the shrinkage in other parts of the casting.

The mechanics of these phenomena have been investigated and reported on at a metallurgical basis, and the principles are now generally appreciated. Briefly, the type of shrinkage-cavity formation is a function of metal composition and mass and its mode of solidification.[3] In practice, irons functioning as stated, can be classified almost directly in relation to their " range of

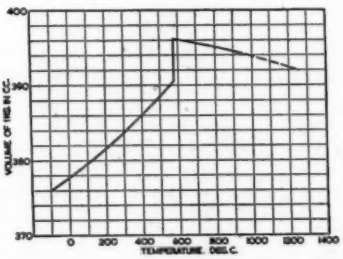


FIG. 7.—*Temperature/Volume Curve for Quartz (after Sosman).*

solidification temperatures " and the carbon-equivalent value, namely:—

(*a*) Soft irons having a carbon equivalent of over 4.3 per cent.;

(*b*) low-carbon irons having a carbon equivalent of under 4.3 per cent.; and

(*c*) irons having phosphorus contents over 0.3 per cent.

In each case, there is a range of function dependent on the metal section and mass and the change from (*a*) to (*b*) is progressive. Segregation of the phosphide eutectic can be present in (*a*) and (*b*) in addition to the classified factor. In the case of (*a*), the constituent fills up the micro-cavities and presents the appearance of a close-grained iron, but reveals local micro-porosity, tending to macro-porosity in the area of hot spots. In (*b*), segregation aggravates the tendency to form large dendritic cavities as stated.

Many foundrymen claim that feeding and densening are unnecessary, but their claims should be investigated and related to the type of metal they are using. It is quite possible to produce medium-weight castings regularly without apparent shrinkage defects if iron of compositon (*a*) and of low phosphorus content is used. However, unalloyed high-duty castings call for metal of high strength and shock resistance, which can only be achieved by compositions low in carbon and phosphorus. The type of shrinkage is therefore, as stated in (*b*). Defects arising from this type of

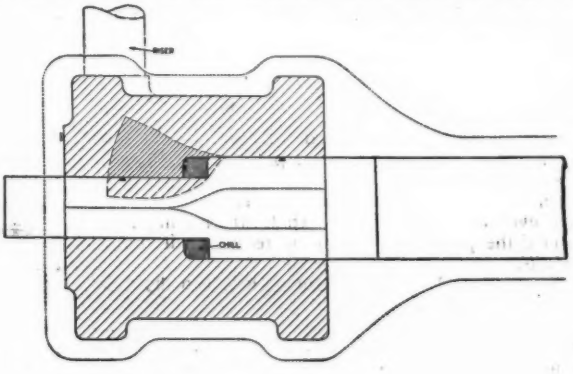


FIG. 8.—*Screw-box Section of a Roll Housing Casting.*

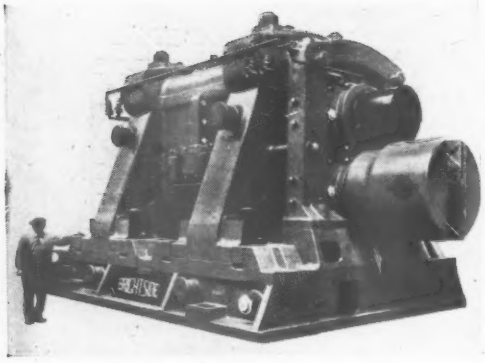


FIG. 9.—*Pinion-housing Casting of a 35-in. Reversing Mill.*

shrinkage can only be eliminated by adequate feeding arrangements and the controlled cooling of isolated masses.

Progressive or Directional Solidification

In theory, progressive solidification is the answer to this problem, but in practice it is difficult to apply. Briefly, the principle calls for methods in which solidification commences at the point furthest from the source of feed metal and progressively moves towards the source of feeding. The feeder-head is kept hot and fluid and solidifies last. Difficulties in arranging these conditions arise mainly out of variations in metal sections, isolated masses and differences in temperature distribution throughout the mould.

To balance the solidification rate in practice, two methods are used:—(*a*) absorption of heat or accelerated cooling of isolated and excessive heat masses that is heavy sections or (*b*) pre-heating or retarding of cooling in areas low in heat mass, *i.e.*, thin sections. The first method is implemented by using metal chills or inserts, which absorb heat from the metal at a greater rate and in greater quantity than the normal mould material. The word "chill" is really a misnomer, the term "heat-blotter" or "heat-absorber" is more appropriate. In principle, the idea is to remove heat from the excessive heat-masses, so that all parts of the casting solidify at about the same instant, feed metal being available at the most advantageous point and in a very fluid condition. The sizes of the metal "absorbers" must be in relation to the heat mass to be absorbed and can be roughly calculated on heat-transfer principles.

Heat Mass Effect

When studying relative heat-masses in a casting, the metal-masses shown on the blue-print are apt to be misleading, the sections should be considered as at the time of solidification, when the surrounding mould material has also a thermal value.

Sharp corners are re-entrant angles and protruding parts of the mould will heat up rapidly during casting and become (after thermal equilibrium is reached) part of the local heat mass. As a result of this, it is possible that the hot spot may be at the face of the casting and in some cases actually outside of the casting. Fig. 8, showing the screw box section of a roll housing casting, illustrates this point.

If a line (isothermal) is sketched around the blue print section, making allowance for the heating up of all re-entrant sand angles and indicating roughly the line of thermal equilibrium between metal and mould faces, a different picture is obtained. Assuming the heat dissipation through the core to be negligible, particularly on the smaller diameter, then the hot spot actually cuts the corner of the core at A. By inserting absorbers at point A to the extent of making the core almost solid metal, the cooling at this point is accelerated, and the risk of a cavitation minimized.

This principle will be found, on study, to apply to a variety of castings. The application of the foregoing principles constitute the main features of the Roll Housing casting.

Pinion Housing Castings

Fig. 9 shows a pinion housing casting made in halves of a 35-in. reversing mill in the finished state. The main features are the same as in the roll housing casting. Fig. 10 shows a pinion housing casting of a different design, *i.e.*, box section solid casting for a 35-in. sheet mill. The same principles are applicable, but the introduction of internal coring increases the difficulty of construction. The core-sand used is the same as that for the mould and special care is required to ensure free passage of the core gases through the limited apertures. Fig. 11 shows this casting in process of being machined.

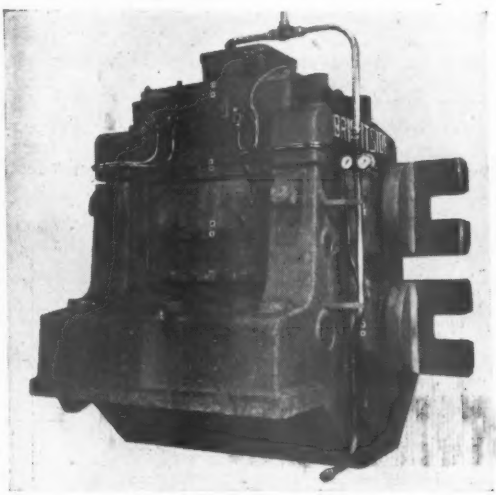


FIG. 10.—*Pinion-housing representing a Box-section Solid Casting for a 35-in. Sheet Mill.*

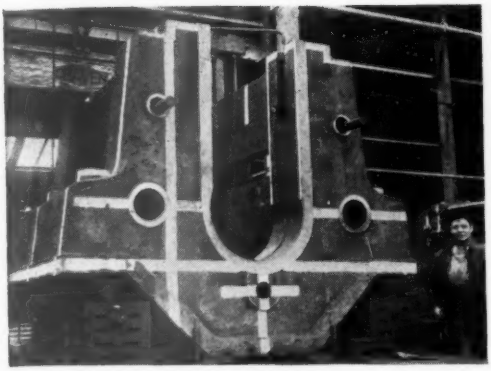


FIG. 11.—*Casting, shown in Fig. 9, during Machining.*

FIG. 13.—*Hammer-block Casting, similar to that shown in Fig. 11, but with Poppet Cores running through the Mass.*

Hammer-block Casting

Fig. 12 shows a typical hammer-block casting (that illustrated weighed 54 tons) representing about the most massive type of casting produced. Apart from the metal composition, the main features of this job are in the control of mould and core materials and the feeding technique. The mould in this particular instance was rammed up from a full pattern, but moulds for many of the larger blocks are bricked-up and strickled in loam using a skeleton frame pattern from which the strickles are worked.

The natural mode of solidification of a mass of this shape whether of the dimensions of a 2-in. cube or of a 8-ft. cube would be for a skin to form on all six faces and for solidification to progress inwards, leaving a cavity in the centre equal to the total volume of liquid shrinkage. However, by adding heat continuously to the top surface, solidification can be arrested and this face made to solidify last. If a feeder-head is placed over this point, complete soundness is obtained.

In practice, this principle is applied by placing a 24-in. dia. feeder-head in the centre of the top-face of the mould. After casting, very hot metal supplied from a cupolette is added periodically. Dross and solid metal broken from the sides of the feeder-head are removed periodically, along with semi-solid metal (primary crystals), before each new addition of hot metal is poured into the feeder-head. The casting is fed until shrinkage ceases, *i.e.*, for 12 to 16 hr., the feeder-head being kept covered with charcoal blacking to retain heat. To complete the feeding operation, additional bushes are added and the feeder-head is topped up with hot metal and well covered with charcoal nibs and blacking. Where a feeder head is of lower mass than the part to be fed, rod-feeding serves no useful purpose unless heat is applied continuously to keep the head from solidifying before the casting.

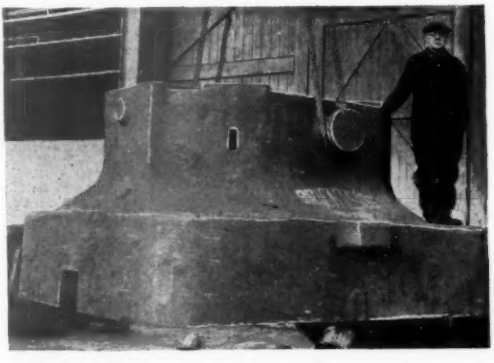


FIG. 12.—*Typical Hammer-block Casting; this example weighed 54 tons.*

Fig. 13 shows a similar hammer-block casting, but attention is drawn to the poppet cores running through the mass of the casting. These are of relatively small section and must be capable of making a clean hole, and of being removed easily by fettling despite their immersion in liquid or almost liquid metal for long periods. Little description is required to show the severity of the conditions that these cores must withstand. The general characteristics required of the core material are:—

(1) Refractoriness under prolonged load.

(2) Extremely fine grain to prevent metal penetration.

(3) Absence of chemical reactivity under prolonged heating.

(4) Complete stability during casting.

(5) No collapse whatsoever due to combustible constituents.

(6) Complete collapse when the casting is fettled.

(7) Green- and dry-strength to facilitate core-making and sufficient permeability to allow free escape of core gases.

The reinforcement of the cores must be given attention, as any material which becomes plastic at elevated temperatures may bend and the cores may lift by flotation.

(To be continued)

F

A.P.V. New Factory at Crawley

The move of A.P.V. Company, Limited, factories from south-west London to Crawley, Sussex, is taking place in two stages, the first of which commenced on July 14 and should be completed by the same time next year. By July, 1953, the Crawley factory should be employing 700 people. It will be manufacturing stainless-steel equipment for the dairy, chemical, brewery, food and defence industries. The factory consists of press shops, foundries, machine-shops, assembly shops and general stores. The factory and foundry consist of 200,000 sq. ft. of covered floor space, of which approximately 160,000 sq. ft. is covered by cranes. Over £70,000 has been spent on the heating installation for the factory and the amenities will be among the most modern in the country. The design of the factory and foundry have been considerably influenced by studies abroad, both in Europe and America. Considerable stress has been laid by the designers on efficient materials handling, and in the factory this will be largely based on the pallet and fork-lift-truck system. In the foundry over £50,000 has been spent on a mechanized system of handling and treating casting sand. The management of the plant will be in the hands of Mr. R. May, the general works manager, who 40 years ago started as an apprentice with the firm. On July 14, Mr. May switched on the first machine to start production at the new factory located at Manor Royal, Crawley New Town. This marks a further step in the concentration of A.P.V. production facilities—at present distributed among four separate factories—in the new 17-acre premises at Crawley. The first batch of machines to commence operation had been transferred to Crawley from the White City factory and installed during the previous week-end, to avoid any break in production.

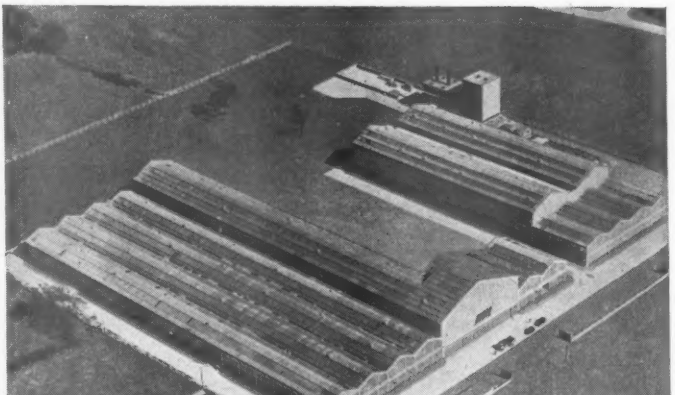


FIG. 1.—*Aerial View of New A.P.V. Works at Crawley, the Site of which Covers 17 Acres.*

Export Licensing Control Changes

Changes in export licensing control are made by a Board of Trade Order which came into operation on Monday. The principal changes include the following: (1) The export of all goods to Tibet is prohibited except under licence; (2) Licences are now required for all destinations for certain mixtures of spirits, rare earth metals, alloys, compounds and mixtures, specified forms of aluminium and titanium (rutile); (3) Licences are now required for nickel catalysts, for all destinations other than those specified in Part II of the Third Schedule, excluding Hong Kong; (4) Specified railway and tramway material are now exempt from export licensing control.

Details of the changes are as follow:—

FIRST SCHEDULE

Under the heading relating to iron and steel the item relating to railway and tramway material and the items thereunder, are amended to read:—"Railway and tramway material (assembled or unassembled, other than points and crossings) the following: Fish plates, rails and rail crops, sleepers and sole plates; rails and rail crops, bridge and crane; scaffolding tubes; tube rounds, squares and hollows, including crop ends; tyres, wheels, wheel centres and axles of the type used for railway or tramway vehicles (assembled or unassembled); welding electrodes and welding rods; wire (plain or barbed), whether coated or not, other than insulated wire; wire rods."

Under the heading "Ores and concentrates of the following descriptions," the item "Iron pyrites (including cupreous pyrites)" is amended to read:—"Iron pyrites (including cupreous, arsenical pyrites, and other iron sulphide ores and minerals)."

After the item "Tin (including matte)" the following item is inserted:—"Titanium (rutile only)."

In Group 11, the item "Rail locomotives and parts thereof" is amended to read:—"Rail locomotives and parts thereof not elsewhere specified in this Schedule."

In Group 13(1), the following is inserted:—"Catalysts of metallic nickel deposited on, or immersed in, other material; compounds of cerium and the other rare earth metals and mixtures thereof."

THIRD SCHEDULE

In Part I, Group 6(1), the item relating to aluminium and alloys containing 50 per cent. or more by weight of aluminium is deleted.

In Group 13(1), after the item "Calcium permanganate" the following item is inserted:—"Catalysts of metallic nickel deposited on, or immersed in, other material."

Steelworks Equipment for Sweden

Davy & United Engineering Company, Limited, Sheffield, shipped out of Hull on August 1 the units of a 56-in. four-high cold sheet and strip mill which it is building for Surahammars Bruks, A.B., of Surahammar, Sweden. The mill is designed for the rolling of silicon sheet and strip.

Insulating Feeders for Use with Copper-alloy Sand Castings*

By R. A. Skinner and R. W. Ruddle

With many copper-alloy castings, specially those in aluminium-bronze and high-tensile brass, the yield of fettled castings to metal melted is often more than 50 per cent. and sometimes less. The rest of the metal forms the feeders and running system and although essential to the making of a sound casting, is unproductive so far as the finished article is concerned. This metal has to be melted, carried to the mould and eventually cut off from the casting—all operations involving man-power and fuel which are, so to speak, unproductive. Clearly, any means of reducing the size of the feeders required without detriment to the casting should result in a saving both of man-power and fuel, with a consequent increase in productivity. It is, of course, important that any method used to achieve this end should be both practical and not too expensive to give savings which are economically worthwhile.

Two methods recently suggested for reducing the size of feeder for castings are the use of (1) exothermic materials, such as Feedex,† and (2) insulating feeder sleeves in gypsum or other insulating materials. Both these methods delay the freezing of the feeder head, thereby enabling it to function much more efficiently; this permits the production of castings of greater soundness or, alternatively, permits the use of smaller feeders with consequently higher yield. Both these methods are coming into use, specially in the United States, but there is little information available on the efficiencies of these techniques compared with ordinary feeding methods. Accordingly, about a year ago the British Non-Ferrous Metals Research Association began an investigation of the subject on behalf of its member-firms. The object of the work was to compare the efficiencies of ordinary feeders with those surrounded with sleeves of exothermic material or gypsum. It was hoped that the information thus obtained would enable the practical foundryman to weigh the extra cost of these new feeding techniques against savings in metal melted and the lower cost of removing smaller feeders, and so to determine whether economic benefits accrued from the use of these methods.

Preliminary Tests

The first step in the investigation was to compare the freezing times of these special feeders with the freezing times of conventional feeders. Since these were preliminary tests the feeders were cast alone and were not attached to any casting. Cylindrical feeders of a height 1½ times their diameter were used as being representative of conventional good-feeding practice. Feeders of diameters in the range 2 to 3½ in. were moulded in (*a*) dry, synthetic sand in the usual way, (*b*) in moulds lined with a ¼-in. thick gypsum sleeve, and (*c*) in moulds similarly lined with a sleeve of exothermic material. The sleeves were made in split coreboxes from metal-casting plaster kindly given by the Gotham Company, Limited, or from Feedex No. 3 supplied by Foundry Services, Limited.

To investigate whether covering the top of the feeder substantially affected the solidification time, two series of feeders were cast in each of the three types of mould. With one series the open tops of the feeders were allowed to radiate freely, but in the other series the tops of the feeders were closed with discs of the appropriate moulding material immediately after pouring. Nitrogen degassed, 85/5/5/5 leaded gunmetal was top poured into each feeder at a pouring temperature of 1,130 deg. C. and the freezing times of the feeders were determined by introducing a thermocouple into the centre of each. The results obtained are shown in Fig. 1, where the freezing times are plotted against feeder size. In this graph, feeder size is represented by the square of the ratio of the volume of

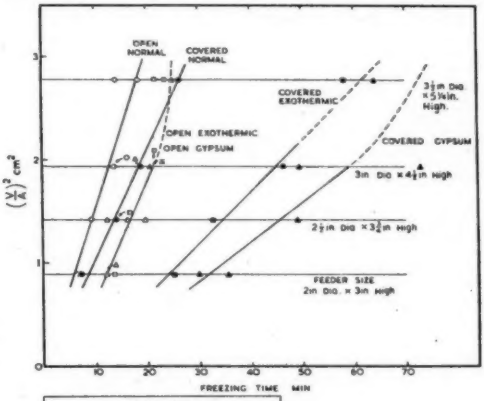


FIG. 1.—*Freezing Times of Feeders plotted against* $\frac{V^2}{A}$ *for the various Types of Mould.*

* Paper presented to the Brassfounders' Productivity Conference at Harrogate.

† Developed by Foundry Services Limited.

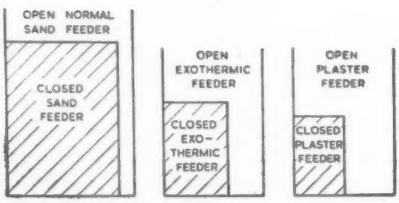


FIG. 2.—*Relative Sizes of Various Kinds of Feeder which would have a Freezing Time of 25 min. in 85/5/5/5 Leaded Gunmetal (approximately ⅛ actual linear size).*

the feeder to its surface area. This method of representation has been used because earlier work has shown that the freezing time of a casting should be proportional to this ratio. The relative efficiencies of the different kinds of feeder are made clearer in Fig. 2, which shows the sizes of different kinds of feeder all of which have a solidification time of 25 min.

The results of these experiments show that (*a*) covered feeders are much more efficient than open ones, and this suggests that feeders should always be covered immediately after pouring. It is a simple matter to pour a little dry sand or insulating material over the tops of the feeders, and in many cases it is even simpler to employ patterns which form blind feeders; (*b*) both exothermic and gypsum insulating sleeves are very effective in increasing the efficiency of feeders, and (*c*) although the open exothermic and gypsum sleeves are about equal in efficiency, the covered gypsum sleeves appear to be more efficient than the covered exothermic sleeves.

Experiments with Plate Castings

The results of this first series of experiments appeared to substantiate the claims which had been made for these improved methods of feeding castings, but it was clear that in order to reach any final decision on the matter it would be necessary to study the influence of gypsum sleeves and exothermic sleeves on the freezing of feeders which were attached to castings. Accordingly, a second series of experiments was put in hand in which plate castings 12 by 6 by 1 in. thick were made in 90/10 aluminium-bronze. Insulated and plain feeders of various sizes were attached to these castings and the minimum size for each type of feeder was found. The results obtained confirmed the beneficial effect of the use of plaster and exothermic sleeves as is shown in Fig. 3.

It was found that about the smallest open conventional feeder which would give a sound casting was 3 in. dia. by 4½ in. with a volume of 485 cc. (Fig. 3 (*a*)), or just over 2½ in. dia. by 3¼ in. with a volume of 300 cc. if the feeder were blind (Fig. 3 (*b*)). On the other hand, the use of a ½-in. thick exothermic sleeve reduced the minimum size of the blind feeder to 2 in. dia. by 3 in. high with a volume of 154 cc. (Fig. 3 (*d*)). If gypsum sleeves were employed, it was found that the minimum size of a blind feeder was further reduced to 2 in. dia. by 1⅝ in. high, the volume of this feeder being 84 cc. (Fig. 3 (*c*)). Thus the use of an exothermic sleeve allowed a 68 per cent. reduction in feeder volume, whilst the use of a gypsum sleeve allowed an 83 per cent. reduction. These results thus confirm the savings that can be made by using insulating sleeves.

Field Trials

To provide another demonstration of the value of insulating feeder sleeves, some experiments were carried out in the works of a member-firm. This firm had been experiencing difficulty in feeding a high-tensile brass axle-box casting shown in Fig. 4; this casting weighs 53 lb. The firm concerned had found that the best results using conventional feeders were obtained by feeding the casting as shown in Fig. 5 (*a*) with a single feeder at one side. The feeder measured 12½ by 4½ by 2½ in. and weighed 41 lb., the casting yield being 56 per cent. In the experimental work the standard feeder was replaced by covered gypsum sleeves of the various dimensions and it was found that the normal sand feeder could be replaced without detriment to the soundness of the casting by a gypsum insulated feeder 3 in. dia. by 4½ in., weighing 9 lb. Thus the feeder weight was reduced by 32 lb. and the casting yield was increased from 56 to 86 per cent.

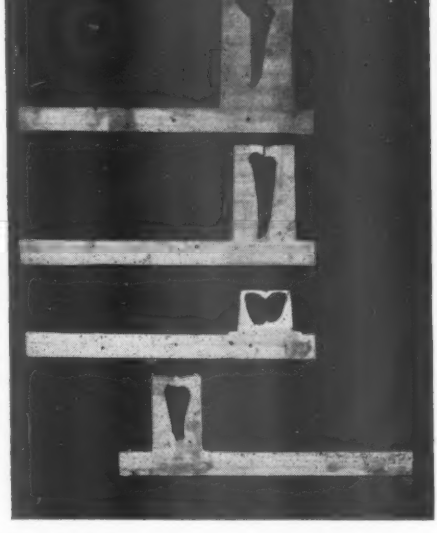


FIG. 3.—*Minimum Size of Various Feeders to give a Sound Plate Casting. (a) Open Normal Feeder 3-in. dia. by 4½ in. high; (b) Blind Normal Feeder, 2½-in. dia. by 3¼ in. high; (c) Blind Plaster-sleeved Feeder, 2-in. dia. by 1⅝ in. high; and (d) Blind Exothermic Feeder, 2-in. dia. by 3 in. high.*

Due to the smaller amount of metal to be melted, and the consequently reduced melting costs and metal losses, the production cost of this casting was reduced by 7½ per cent.

Discussion of Results

The results of these experiments make it clear that the use of gypsum sleeves or exothermic materials should enable foundrymen to reduce substantially the size of the feeders attached to their castings and thus to increase the yield. Alternatively, or in addition, the use of these new techniques should result in considerably better feeding and sounder castings. However, factors other than those which are purely metallurgical must be taken into account in assessing the value to the industry of the new methods. The most important of these other factors are cost, ease of handling, fire hazard and danger of contamination of the moulding sand.

Exothermic materials have the advantage of being easy to mould, normal core-making techniques sufficing. After use, the sleeves are fairly strong and may remain on the feeder during knock-out. On the other hand, this material is expensive and care is required during drying to avoid premature ignition. Gypsum sleeves are also easy to make and have the further advantage of cheapness. In the earlier experiments, difficulty was experienced due to the hygroscopic nature of of the material and its lack of permeability, which would result in severe blowing unless a rather high drying temperature were used and the sleeve was subsequently prevented from absorbing moisture from the atmosphere. However, it was subsequently found possible to make highly-permeable plaster sleeves which enabled this difficulty to be avoided. These plaster sleeves were made from a special plaster, this again being given by the Gotham Company, Limited. A small quantity of wetting agent is added to water used for mixing

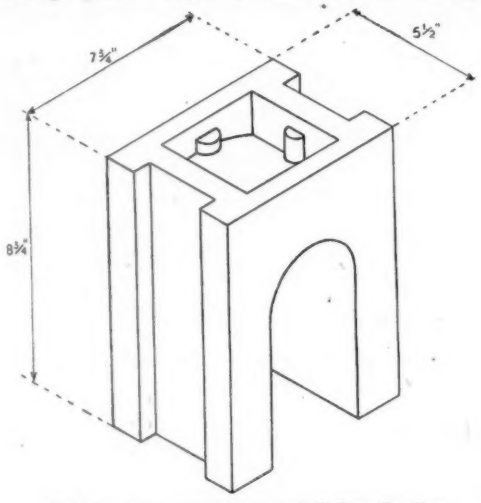


FIG. 4.—*Manganese-bronze Axle-box Casting.*

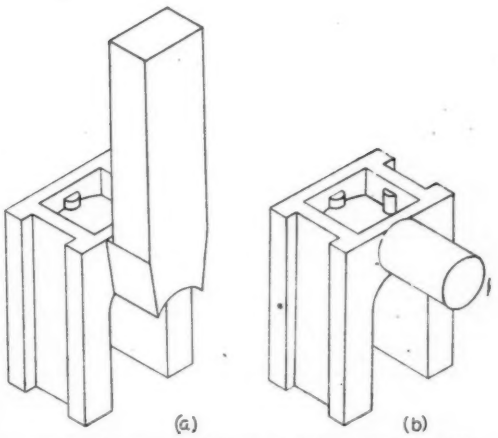


FIG. 5.—*Manganese-bronze Axle-box Casting with (a) Normal Open Feeder, 12 in. high by 4¼ in. by 2½ in., and (b) Equivalent Gypsum-sleeved Blind Feeder, 3-in. dia. by 4½ in. long.*

the plaster, which is then whipped up into a foam. This is quite easily achieved and in the experimental work an ordinary egg-beater was employed. The plaster is mixed with water and made into a slurry in the normal way. The foam is then mixed in with this slurry and the foamed slurry is poured into the mould. Feeders made in this way and dried at 110 deg. C. on a core-oven have permeabilities in the range 30 to 200 units and no trouble from blowing is experienced. No special precautions to avoid moisture pick-up were found to be necessary.

A possible objection to the use of gypsum sleeves is their fragility, which may result in crumbling during knock-out and contamination of the sand with plaster. Although gypsum sleeves have shown no signs of fusion or decomposition when filled with metal at about 1,150 deg. C. it is possible that they may disintegrate at temperatures not very much higher. If this should prove to be the case, it will be necessary to seek another insulating material for use with alloys of higher melting point.

Advantages and Disadvantages

When the advantages and disadvantages of these new methods of feeding are weighed up, it seems clear that their use is unlikely to be economic with ordinary small castings whose feeders are less than about 2 in. dia. On the other hand, with special castings where feeding is difficult and good feeding is imperative, use of either gypsum sleeves or exothermic materials should be of considerable benefit. The value of these techniques in making larger castings of ordinary quality and which are not especially difficult to feed is less certain, but their use should clearly be given careful consideration by foundrymen, in view of the substantial savings in metal and improvement in feeding which should accrue. Feeder sleeves should be most

valuable in the case of really large castings with heavy feeders, where the economies effected may outweigh the extra trouble and expense by a good margin.

A further advantage of feeder sleeves which must be borne in mind is that the reduction effected in the size of the feeder greatly facilitates its removal after casting. Furthermore, feeder sleeves can readily be made to incorporate a Washburn core which makes the feeder heads even easier to remove. This advantage should be of particular value with large feeders. Another possible use for insulating sleeves is for hot-tops for ingots and their use here should considerably reduce piping and the weight of the discard.

It is emphasized that work on this subject is still in progress and that the conclusions so far reached are still provisional. However, enough work has already been done to show that these new methods of feeding have considerable potentialities and are likely to be of great value in making the larger type of bronze casting. The Authors thank the director and Council of the British Non-Ferrous Metals Research Association for permission to publish this Paper.

DISCUSSION

MR. A. TIPPER drew attention to a few specimens he had brought along, showing the application of insulating plaster sleeves as illustrated by four block castings in L.33 aluminium alloy. Just the same sort of features as described in the Paper were shown up, and unless one used a covered riser the effect of the sleeve was very much reduced in efficiency. The first section was cast in sand and showed porosity right down the whole bar, the feeder obviously being insufficient in diameter. The second casting, in which a plaster sleeve was used but with no insulating cover, there was again porosity and feeding had been restricted by prior solidification of the head. In the third example the freezing time had been increased from eight to sixteen minutes, and again in the last example the setting time was fifteen minutes and the casting was completely sound.

In addition to the satisfactory results obtained with the Gotham Company's plaster, he had also shown that satisfactory results could be obtained with ordinary casting plaster which was not permeable, when drying was adequate. The particular samples were dried at from 200 to 210 deg. C. for 16 to 20 hrs. (overnight).

Comparative Conductivities

DR. D. V. ATTERTON said the use of feeder solidification time as a measure of feeder efficiency was probably a fair approximation although, as the Authors had indicated, one felt that the degree of superheat of feeder over that of the casting and the relative rates of cooling of feeder and casting were probably more relevant. He had been carrying out an investigation on behalf of the British Steel Founders' Association on the thermal conductivity of moulding materials over the temperature range 20 to 1,600 deg. C. and a few of those experiments confirmed that the thermal conductivity of plaster materials was less than that of fired exothermic compounds, and also showed that the conductivity of both was less than that of typical silica moulding sands, particularly at high temperatures. At room temperature, the ratio of the conductivity of the exothermic sinter to that of plaster was about 7 to 1; however, in contrast to that of the plaster, the conductivity of the sinter decreased initially with increasing temperature, so that by about 750 deg. C. the ratio of the conductivities was only 3 to 1. In the case of the plaster, measurements of the conductivity could not be made above 1,000 deg. C. due to a very marked sintering which led to cracking and deterioration of the plaster. Such sintering might be of considerable importance in practice and might prevent the use of such sleeves for large, high temperature, non-ferrous castings. However, results were not of present importance since plasters were not much used above that temperature.

The Authors had shown clearly that both plaster and exothermic materials increased the efficiency of feeders, but he felt that a true comparison between the two materials could not be made on the basis of relatively few experiments. For example, a comparison should certainly consider the variation of solidification times with varying metal superheats, since the purpose of exothermic materials was twofold: (*a*) to superheat the feeder metal and (*b*) to insulate this superheated metal and reduce its rate of cooling relative to the casting bulk. On the other hand, plaster-type materials acted solely by providing better insulation to the feeder as compared with the casting bulk. Consequently, with a low metal superheat which was often preferable from the point of view of minimizing surface defects in the casting, an exothermic material might be expected to be more efficient than a plaster material, whereas at higher superheats the converse might possibly be true.

Experimental results shown by Foundry Services Limited, which were obtained from experiments similar in principle to those of Ruddle and Skinner, where such variables as type of metal, metal superheat, feeder size, and particularly sleeve-thickness were taken into consideration, showed that exothermic materials gave greater solidification times in all cases. He then showed an illustration of a typical set of experiments on 85/5/5/5 gunmetal, supporting this contention.

MR. R. A. SKINNER, in reply, said it was interesting to see substantiated the figures he and his co-Author had obtained. It was true that they had relatively few experimental results available as they had not long been engaged on the actual work on the use of the sleeves on castings. However, it should be borne in mind that, to increase the thickness of the sleeve, which, according to Dr. Atterton, appeared to be necessary in order to get feeder efficiency, increased the cost differential between the two methods. As to the production of sleeves, he did not really see why the production of plaster sleeves should be much slower, provided one went

about it in a properly-organized manner. It would be necessary to have sufficient moulds to run a continuous system, but if that were done the time per sleeve should be quite small. The drying of the permeable sleeves was quicker than the others could be done at a much lower temperature (110 to 200 deg. C.). Sand contamination was something which could only be investigated when sleeves were used under works conditions, because it was not known what sort of handling they would get in the knock-out.

Referring to Mr. Tipper's remarks, the use of sleeves on L.33 alloy was very interesting, although he would have imagined that the difference between the open and closed sleeve would be less marked in the case of the light alloy because at that temperature the radiation losses were considerably lower. Radiation losses increased rapidly with the temperature.

MR. E. C. MANTLE pointed out that Dr. Atterton's illustration was itself based on only a few results. The Author's experiments had been repeated with a large number of feeder sizes and a whole range of curves had been obtained which substantiated the results shown in Fig. 1; he therefore disagreed with the inference that there was insufficient evidence to substantiate their views.

One indication of Dr. Atterton's remarks was that plaster sleeves were useless at temperatures above 1,000 deg. C., but in the experiments described by Mr. Skinner the sleeves had behaved perfectly well in contact with aluminium-bronze at 1,150 deg. C. While he was not suggesting that they would be suitable for Monel-metal he thought there would be a useful field with many copper-base alloys. The permeable plaster seemed to overcome the difficulty about long stoving times, and he thought Dr. Atterton had exaggerated the practical difficulties of adopting sleeves of that type.

MR. H. ROTH asked whether it was possible to use the plaster as inserts in the mould in order to help directional solidification of the casting at a difficult point where cooling-off might be experienced, and also the maximum temperature at which it could be used. Was it possible for Dr. Atterton to say to which moulding sand his figures for thermal conductivity applied?

MR. SKINNER replied that the idea of plaster inserts to delay freezing had not occurred to him but it would seem to be quite practicable, although the use of a permeable plaster plus adequate venting would be essential. He did not think it would be possible to go very much beyond 1,150 deg. C. or perhaps 1,200 deg. C. when using plaster, but for higher temperatures the exothermic materials and materials such as vermiculite, or Perlite, which had recently been used by the Americans, were suitable.

DR. ATTERTON said that his research had been carried out with a typical sand used by steelfounders.

MR. C. L. HADDON (Gotham Company, Limited) pointed out that the B.N.F.M.R.A. had used a specially-compounded plaster known to be suitable and made by a specialist firm of plaster manufacturers, whereas he did not know what plaster Dr. Atterton had employed. It was certainly a different plaster and this difference probably caused the change in results.

(*continued at the foot of Col.* 2)

DR. ATTERTON expressed the belief that it was the same as that quoted in the paper as " typical British fine plaster."

MR. R. A. MILLER said it was apparent that many opportunities for using heat-insulating and -producing materials had been missed in the non-ferrous fields, particularly for manganese-bronze and high-tensile brass; he then showed three illustrations demonstrating practical applications.

Wholesale Price Index Numbers

The decline in the Board of Trade's basic materials index continued between May and June with a fall of 1.5 per cent., the latest figures show. The fall in this index since November, 1951, is now 12.2 per cent. and since the peak in March, 1951, is 27.5 per cent.

The index for materials used in mechanical engineering remained almost unchanged, but the corresponding electrical machinery index, which fell slightly the month before, resumed its previous upward movement—mainly because of the rise in copper, offset to some extent by the falls in lead and zinc.

The following tables give, respectively, the price index numbers of materials for industry and of industrial output for the first six months of this year, on the basis that June 30, 1939 = 100.

Price index numbers of materials for industry—June 30, 1949 = 100.

	Jan.	Feb.	Mar.	Apr.	May.	June.
Basic materials (excluding fuel) for non-food manufacturing industry	181.5	177.0	169.6	164.7	162.1	159.7
Materials used in mechanical engineering industries	143.2	143.6	152.2	152.6	151.7	151.7
Materials used in the electrical machinery industry	160.0	160.2	165.4	166.3	165.5	167.6
Building and civil engineering materials	134.4	134.8	136.8	137.3	134.9	134.5
House building materials	130.0	131.4	132.9	133.4	131.8	131.9

Price index numbers of industrial output—June 30, 1949 = 100.

	Jan.	Feb.	Mar.	Apr.	May.	June.
Coal	122.1	122.6	122.8	122.8	121.1	121.2
General chemicals	134.9	137.0	138.5	138.7	138.5	138.3
Blast furnaces and iron and steel melting and rolling	125.3	127.1	142.6	142.6	142.6	142.6
Iron and steel—sheets	125.0	126.8	139.6	139.6	139.6	138.1
Iron and steel—tinplate	126.7	129.3	137.9	137.7	137.7	137.7
Iron and steel—tubes	118.1	119.4	130.9	130.9	130.8	130.5
Cutlery	111.9	111.9	111.9	111.9	111.9	111.9
Domestic hollow-ware	124.6	130.7	132.9	133.3	134.9	134.7

Engineering Training Mission

The British engineering training mission to Latin-America, consisting of Sir Arthur Fleming, chairman of the F.B.I. overseas scholarships committee, Mr. F. R. Livock, a member of the committee, and Mr. W. V. Jenkins, who administers the F.B.I. overseas scholarships scheme, has now completed its tour in accordance with the terms of reference, approved by the Board of Trade and the Federation of British Industries. The mission, which has returned to this country, left England on April 29 and visited Colombia, Venezuela, Cuba, Mexico, Peru, Chile, the Argentine, Uruguay, and Brazil, travelling over 20,000 miles and spending one week in each country and two weeks in Brazil.

Oxygen-cutting of Nodular-graphite Cast Iron

The operation of cutting mild steel with oxygen is well known. The cutting of cast iron with oxygen is carried out much less frequently because it is a much more difficult operation. Cast irons can be cut if a special technique is adopted, which involves a particular torch movement and this restricts the operation to the use of a hand-controlled torch. Even when this is used, the operation is slow and the quality of the cut face is never as good as that obtained on mild steel. Furthermore, the kerf width is much larger than in the case of mild steel. This is true of most common foundry irons.

Can Use Standard Machines

Nodular-graphite cast iron, however, behaves quite differently from most foundry irons, in that it can be oxygen-cut almost as easily as mild steel. The operation can be carried out continuously on a standard oxygen-cutting machine.

The accompanying photographs illustrate the marked difference in appearance between a flake-graphite grey cast iron oxygen-cut by the normal hand method and nodular-graphite iron oxygen-cut by machine. The data relating to these two specimens is given in Table I.

TABLE I.—*Gas Consumption and Cutting Speeds for Grey and Nodular-graphite Cast Irons.*

Specimen 4 in. thick.	Gas consumption, cub. ft. per ft. cut.		Cutting speed, ft. per hr.
	Total oxygen.	Fuel gas.	
Grey cast iron, pearlitic ..	150	10	5
Nodular cast iron, as cast, pearlitic	16.5	0.7	30

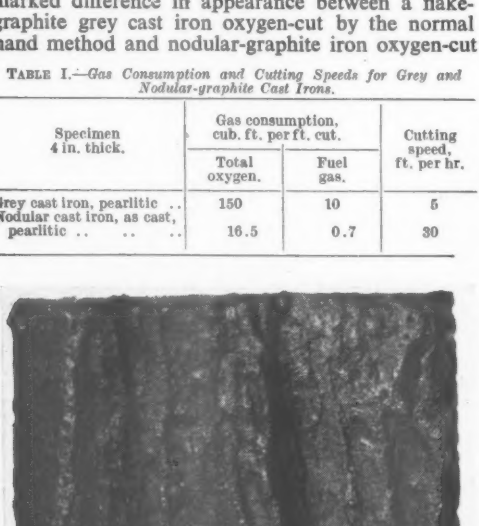


FIG. 1.—*Oxygen-cut surface of Normal Grey Iron.*

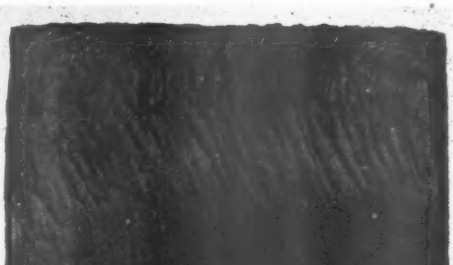


FIG. 2.—*Oxygen-cut surface of Nodular-graphite Iron.*

The great difference in the cuttability of the two types of iron is attributed to the form of graphite present. In the normal grey cast iron, the flakes of graphite present a relatively inert face to the oxidation front. This face could be almost continuous in localized areas. With the spheroidal-graphite cast iron, where the graphite has been nodularized, there is no continuous obstruction to the oxidation process; there is always a free path between the graphite by reason of its form. It should be noted that in both irons the matrix was pearlitic, the only difference in the microstructure being the form of the graphite. No difference was noted in the cuttability of annealed and "as-cast" nodular iron.

In common with other irons, the nodular-graphite iron does surface harden on oxygen-cutting but it is possible to remove this effect by flame-tempering the surface after cutting. As in high-carbon steel, cracking may result from oxygen-cutting, but would be avoided by suitable preheating of the metal to be cut. It would thus seem that the oxygen-cutting of nodular-graphite cast iron has a potential use in the removal of risers from large castings in the foundry.

Institute of Metals Oxford Meeting

The annual autumn meeting of the Institute of Metals will be held at Oxford from September 15 to 19 inclusive. On the evening of September 15, Prof. H. W. Swift will present the 23rd autumn lecture on plastic deformation of metals. Some six papers of industrial interest will be given, also four dealing with physical metallurgy and 12 on alloy constitution. An informal discussion on "Grain Boundaries" is being arranged by the Metal Physics Committee.

Rôle of the Research Foundry Unit*

By G. A. Lillieqvist

(*continued from page 151*)

Welding Electrodes

In recent years, considerable pressure has been exerted on the steel foundries to use better welding electrodes. Many customers' specifications require that the weld deposit shall have approximately the same chemical analysis and mechanical properties as the parent metal. Readers will realize that it is a difficult problem to match the composition of the weld deposit with the parent metal, especially in the higher-carbon ranges. However, satisfactory welding electrodes have now been developed which will give approximately the same physical properties in the weld deposit as in the parent metal. This holds true for various heat-treatment operations such as normalizing and tempering, quenching in liquid media and tempering. In order to evaluate various welding electrodes, a test-casting was designed as shown in Fig. 16. Tensile test-bars and Charpy impact specimens are removed from the casting as indicated after the appropriate heat-treatment. If the welding electrode meets the properties with a sufficiently-large factor of safety, it is recommended to co-operating foundries where further experiments are carried out. Should the welding rod be satisfactory at all the plants, this rod will be adopted as standard. Only lime-ferritic or low-hydrogen-containing welding electrodes are being considered, both for the d.c. and a.c. welding machines. Incidentally, the same test-casting is used at co-operating foundries for qualification tests of individual welders. Before a welder is permitted to weld on critical sections of a casting, he must produce a weld in the test-casting which meets a radiographic standard as well as the required physical properties. Should he fail to meet the requirements, he will be given another test. Failure later to qualify necessitates the man's removal from this occupation.

Many other experiments are being carried out both at the foundries and at the research laboratory, especially with regard to the removal of gates, risers and various foundry defects. This problem is nation-wide and the research committee of the Steel Founders' Society of America undertook an excellent project of this subject. Reference should be made to Research Report No. 26 on the subject of "Metal Removal in the Cleaning of Steel Castings."[6]

Inspection

In co-operation with the foundries the laboratory has set up radiographic and Magnaflux standards for the most important castings, such as railway side-frames, couplers, yokes, brake-beams and bolsters. Such standards are only applicable to long-run repetitive work. The castings are divided into various zones, where zone 1 is a highly-stressed area, zone 2 a medium-stressed area and zone 3 a low-stressed area. Zone 1 will have to meet the highest standard, must be entirely free of internal and external cracks and only small amounts of lack of fusion, porosity, sand inclusions and shrinkage are permitted. These standards have been set up by correlating data obtained through many years' experience, testing castings statically, dynamically and in service.

The laboratory is searching for a more positive and more rapid method of Magnafluxing unmachined castings. The use of copper prods for Magnafluxing castings is being discouraged, due to the fact that at the point of contact of the copper prod, a small hardened area will be obtained which might develop into small cracks. Other methods of Magnafluxing are being investigated such as the coil method, Magnaglo, and others. The use of dye-check, etching tests and ultrasonic testing methods are continuously under consideration.

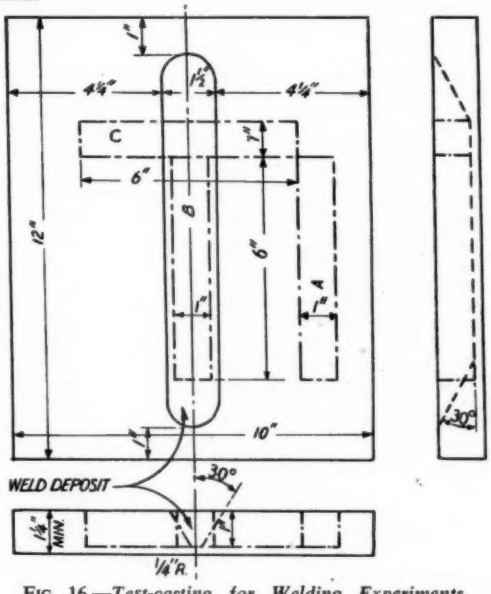


FIG. 16.—*Test-casting for Welding Experiments. Specimens to be Prepared in Accordance with Procedure Outlined in A.A.R. Spec. M-201 (Latest Revision). Type of Test Specimen: "A"—Parent-metal Tensile Specimen; "B"—Longitudinal Weld-metal Tensile Specimen; "C"—Transverse Weld-metal (Heat-affected Zone) Tensile Specimen.*

*Official Exchange Paper from the American Foundrymen's Society presented to the Buxton Conference of the Institute of British Foundrymen.

Table IV—Room-temperature and Sub-zero Tests in Various Rare-earth-treated Steels; Normalized Results.

Steel.	Special addition.	Yield, tons per sq. in.	Tensile, tons per sq. in.	Elong., per cent.	Red. of Area, per cent.	Charpy, ft.-lb.	
						R.T.	— 40 deg.
1	No rare-earth	20.2	33.9	30.4	52.7	35.9	11.8
1	Rare-earth	20.5	34.0	30.6	56.3	48.0	15.8
2	No rare-earth	24.9	41.7	24.1	37.8	19.5	7.8
2	Rare-earth	25.9	42.0	25.4	45.4	23.4	9.4
3	No rare-earth	28.5	41.6	27.9	55.3	46.8	18.1
3	Rare-earth	28.7	42.6	28.9	60.6	52.5	23.1

Steel.	C.	Mn.	Si.	P.	S.
1	0.26	0.70	0.45	0.015	0.032
2	0.43	0.70	0.45	0.015	0.032
3	0.30	1.60	0.45	0.015	0.032

Higher Physical Properties

In the last few years the British have done a great deal of work in the use of cerium in order to improve the properties of cast iron and have succeeded in developing the ductile or spheroidal cast iron. This work has been followed with great interest in America, and is now in limited commercial use, except that the cerium has been substituted by magnesium and various magnesium alloys. The personnel of the steel-castings industry became very much excited about these magnesium-alloy additions for deoxidation purposes and started some experiments. It soon became apparent that these alloys, due to excessive "fireworks," were too hazardous in the steel foundry. The magnesium content in the alloys had to be lowered to a maximum of 6 per cent. and no beneficial effects were obtained.

It was therefore decided to experiment with cerium and Mischmetals, which are generally known as rare-earth elements. In Table IV, the physical properties and the Charpy-impact values at room temperature and at −40 deg. F. are tabulated in the normalized condition with and without the rare-earth element additions to a (1) plain low-carbon steel (C −0.26 and Mn −0.70 per cent.), (2) a medium-carbon steel (C −0.40, Mn −0.70 per cent.) and (3) an intermediate manganese steel (C −0.30, Mn − 1.60 per cent.).

Note the improvement in the ductility and Charpy-impact values, both at room and sub-normal temperatures. In Table V, the same steels are shown in the quenched and tempered condition; again, the same properties are increased to a considerable degree. The steels were made in a basic-lined induction furnace, deoxidized in the regular manner with aluminium and calcium/silicon and then followed with additions of 2 lb. of Mischmetal per ton of charge. Mischmetals contain fifteen different rare-earth elements, such as cerium, lanthanum, praseodynium, neodynium, samarium and all the other rare-earth elements which are listed in the chemical periodicals.

Certain changes can be observed under the microscope which, no doubt, are partly responsible for the superior physical properties. In Fig. 17 the type of the inclusions are shown from a steel made with and without the additions of rare-earth elements, photomicrograph "A" representing the steel without the special additions and "B" with the additions.

Steel "A" contains type III or crystalline inclusions, while steel "B" has type I or round inclusions. It is well known that if cast steels have predominately type I inclusions superior properties are obtained. However, the Author does not believe that this change in non-metallic constituents is entirely responsible for the remarkable increase in the ductility and impact values. In Fig. 18, the same steels, after a normalizing treatment, are shown in the etched condition. No significant difference can be observed and this holds true for the normalized and quenched-and-tempered steels. Further research studies were made with these steels, especially to determine their relative influence on fluidity and hot-tearing. Fig. 19 shows the fluidity curves at various mould-entering temperatures. The fluidity of the steel treated with rare-earth elements is increased, especially at the low mould-entering temperatures.

Fig. 20 shows the influence of rare-earth elements on the occurrence of hot-tears as determined by

Table V.—Test Results for Various Steels after Quenching and Tempering (Steel Compositions as given in Table IV); Quenched and Tempered Results.

Steel.	Special addition.	Yield, tons per sq. in.	Tensile, tons per sq. in.	Elong., per cent.	Red. of area, per cent.	Charpy, ft.-lb.	
						R.T.	— 40 deg.
1	No rare-earth	36.2	46.8	18.3	46.5	33.3	25.7
1	Rare-earth	36.1	46.4	20.2	50.8	42.5	34.7
3	No rare-earth	52.8	56.5	16.2	38.2	27.8	23.8
3	Rare-earth	52.5	56.1	18.2	47.1	42.5	34.8
2	No rare-earth	61.1	69.1	11.5	30.5	17.0	16.0
2	Rare-earth	62.9	70.6	15.2	44.6	27.8	23.7

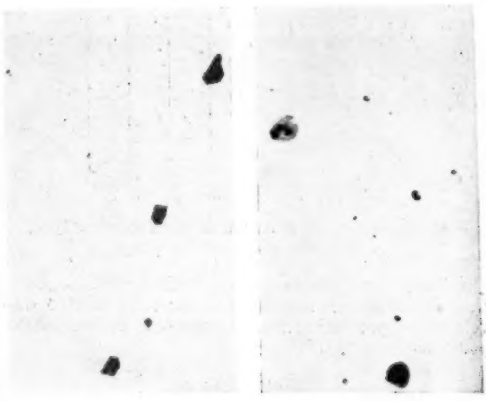
the specially-designed test-casting. Note the lower, hot-tear rating with the addition of rare-earth elements which, no doubt, is partly due to the change from type-III inclusions to type-I. It is indeed a very promising and interesting field for further research, posing such questions as:—What changes occur to the gases in the steel with these additions; what changes occur to the sulphur in the steel? While all the reasons are not yet established, the Author knows of several processing applications for cast steel treated with such additives.

New Deoxidizers and Desulphurizers

It would be of great benefit to the steel-castings industry and especially to the acid-open-hearth and the acid-electric-furnace producers, if some alloy could be developed which would act both as an efficient deoxidizer and desulphurizer. This problem has been under consideration for many years, but no entirely satisfactory solution has been found. However, progress has been made and there is no doubt that such an alloy for the purpose intended will be commercially available to the industry in the not-too-distant future. Various encouraging experiments have been made with sodium additions, but, due to the hazard involved in introducing this metal into the liquid steel, more experimental work is necessary. Other alloys in various combinations which have exhibited great promise are the calcium/manganese/aluminium variations. A typical alloy with which the Author had some success, both in basic and acid practices, had the following approximate percentage composition:—calcium 20, silicon 45, and aluminium 12. A decrease of approximately 5 points in the sulphur content is being obtained with this alloy combination. Perhaps, by increasing the calcium and lowering of the silicon content, a greater sulphur elimination can be obtained. In co-operation with the alloy producers, further work is contemplated and it is hoped that by greater sulphur reduction higher physical properties and fewer occurrences of hot-tears may result.

"C" or Shell-moulding Process

Since the second World War considerable experimental work has been done in both Britain and America to develop the "C" process named after Croning of Hamburg, Germany. There is no doubt that this process has tremendous merits, not only from an economical viewpoint, but also from a casting quality viewpoint and every effort should be exerted to increase research on it. It has been reported that in the non-ferrous, as well as in the grey iron and high-alloy casting industry, considerable progress has been made. The Author has experimented with this process for approximately 2½ years. All of the experiments were made with induction-furnace heats of plain medium-carbon steels, deoxidized in the standard manner with aluminium and calcium/manganese/silicon. Fig. 21 illustrates the shell core used for the experiments. This core is the same as is being used for the centre-core in the hot-tear experiments. No difficulties whatsoever were encountered in producing the cores when



(*a*) (*b*)

FIG. 17.—*Change from Crystalline to Round Inclusions after Rare-earth Additions; Micrographs (a) Crystalline Inclusions; (b) Round Duplex Inclusions.* × 250.

approximately 6 per cent of the special phenolic resins were used. The cores were smooth and strong with sufficient permeability.

However, after the casting had been produced, sections were removed and etched in hot hydrochloric acid. Upon examination, small defects were encountered as illustrated in Fig. 22. These defects are small blowholes and are surrounded by steel high in carbon content as detected by a microscopic examination. This carbon "pick up" is, no doubt, due to a hydrocarbon evolution from the phenolic resin which carburizes the steel. This undesirable condition is shown in Fig. 23.

Many different phenolic resins have been tried, but in all cases the same results were obtained. It is impossible to relate all the experiments, but it can be stated that, so far, no success has been

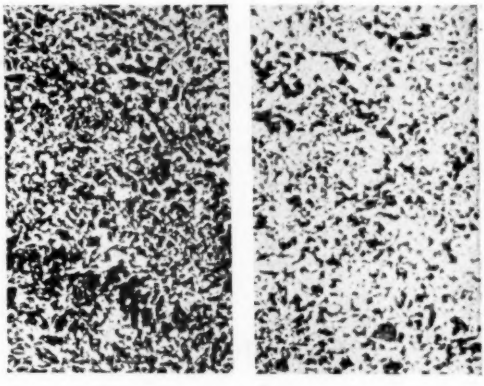


FIG. 18.—*Similar Steels to those shown in Fig.* 18 (1.60 *Mn Steel*) *after Normalizing* (*etched*). × 100. (*a*) *No Rare Earths,* (*b*) *Rare Earths Added.*

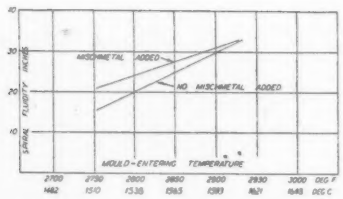

MISCHMETAL ADDED
NO MISCHMETAL ADDED
SPIRAL FLUIDITY INCHES
MOULD-ENTERING TEMPERATURE
2700 2750 2800 2850 2900 2950 3000 DEG F
1482 1510 1538 1565 1593 1621 1648 DEG C

FIG. 19.—*Effect of Mischmetal on the Fluidity of Intermediate Manganese-steel.*

obtained. The laboratory is continuing to concentrate its efforts in search of other materials to develop this promising and economical procedure to produce cores shells.

Phenolic Resins

Whilst on the subject of phenolic resins, the Author would like to mention that he was greatly interested in the Institute's report and recommendations of sub-committee T.S. 30 on the subject of "Synthetic Resins in the Foundry."[7] During the last few years, the managements have experimented a great deal at their foundries with the use of phenolic resins. It is pleasing to report that very few difficulties have been encountered and that approximately 75 per cent. of the cores used are now made using the resins. The method is more economical, because the baking cycles have been shortened and the quality of the castings has not suffered. It is simple to determine if a core has been underbaked as it is only necessary to drive out the moisture during the baking operation. With oil-bonded cores, it is impossible to determine when the core is properly baked; even though the moisture of the core has been eliminated, the oil must be polymerized or oxidized to a certain degree in order to obtain a satisfactory core which will result in a casting free of defects.

Carbon "Pick-up" from Cores

As in all steel foundries, suddenly and in many cases for inexplicable reasons, certain difficulties arise and management, foundrymen and metallurgists are feverishly trying to find the cause and correct the conditions. Occasionally, a man from the research-laboratory organization has to be delegated to determine the cause and remedy. This is termed as "service work for plants." Not so long ago

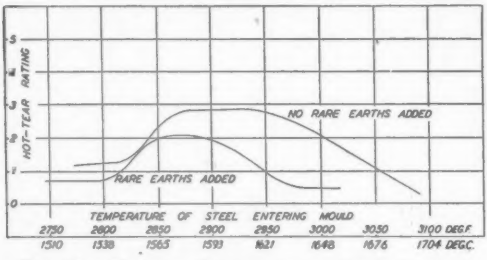

HOT-TEAR RATING
NO RARE EARTHS ADDED
RARE EARTHS ADDED
TEMPERATURE OF STEEL ENTERING MOULD
2750 2800 2850 2900 2950 3000 3050 3100 DEG F
1510 1538 1565 1593 1621 1648 1676 1704 DEG C

FIG. 20.—*Hot-tear Occurrence in Grade-B Steel containing* 0.035 *Sulphur, with and without Rare Earths added.*

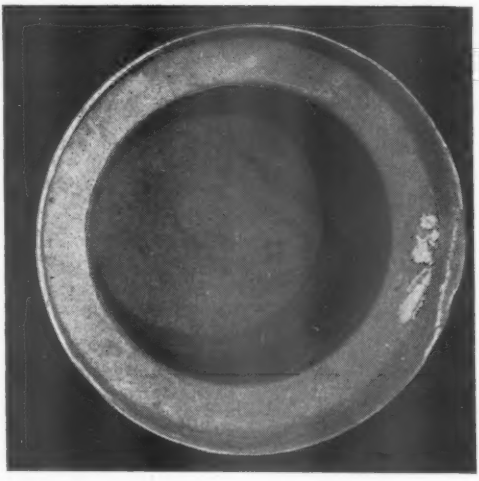


FIG. 21.—*Shell Core used for "C"-Process Experiments.*

there was one interesting case which the Author would like to relate as others might have experienced the same difficulties. At one of the inspecting foundry's machining sources and on some of the castings, machining difficulties were encountered due to hard spots. The castings were made in a low-carbon steel and should have been entirely satisfactory. A section containing the hard spots was removed and microscopically investigated. To the Author's surprise, directly at the surface a small layer of higher-carbon content was observed which, in personal opinion, was responsible for the machining difficulties. This carbon "pick-up" at the surface is shown in Fig. 24. The core-mix in this area was then investigated and was found to be responsible for the increase in the carbon content. The mixture was changed by eliminating some of the organic binders and the undesirable condition was

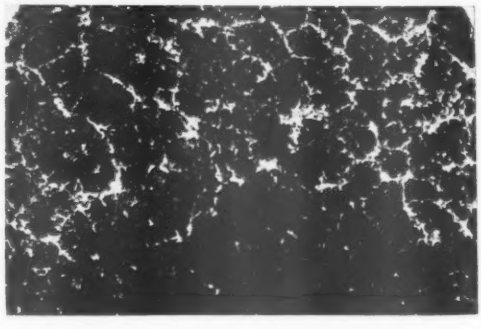


FIG. 23.—*Photomicrograph showing Steel Carburized from the Phenolic Resins used in "C" Moulds.* × 100, *Etched.*

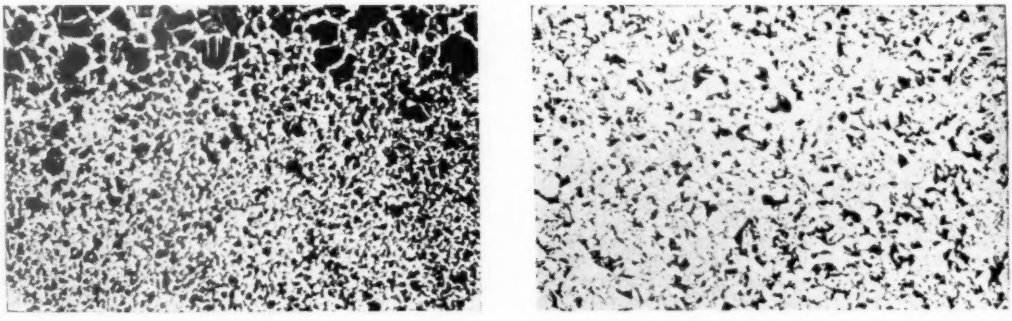
FIG. 22.—*Small Blowholes surrounded by High-carbon Steel in Castings made in "C" Moulds.*

corrected. The laboratory is thankful that such cases are not too frequent as they take time away from its main job—research.

Service-failure Investigations

The subject of service-failure investigations could be easily handled by just saying "We do not have any!" However, nobody would believe such a statement because it is well-known that in all foundries, and in fact in all industries, something will occasionally go wrong. The laboratory is reducing service-failures as much as possible through the medium of improved design, service-testing and the use of statistical quality-control. Such procedures should be encouraged in all sections of the foundry industry. Should a casting fail in service, the laboratory welcomes an investigation as it often yields new ideas as to further research work for the safety and well-being of mankind.

The Author wishes to express his deepest appreciation to Mr. C. G. Mickelson, Mr. J. A. Rassenfoss and Mr. J. D. Wozny, as well as to the officials of the American Steel Foundries group for giving their permission to publish this Exchange Paper.



(*a*) (*b*)

FIG. 24.—*Incidence of a Skin of High-carbon Steel; Micrograph, (a) showing Carbon Pick-up, and (b) No Carbon Pick-up.* × 100, *Etched.*

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[5] C. W. Briggs and B. Gezelius, "Studies on Solidification and Contraction in Steel Castings—IV—Free and Hindered Contraction of Alloy Steels." Trans. of the American Foundrymen's Association, Vol. 44 (1936).

[6] Technical Research Committee, Steel Founders' Society of America, Charles W. Briggs, "Metal Removal in the Cleaning of Steel Castings" (September, 1951).

[7] Report and Recommendations of Sub-committee T.S.30 of the Institute of British Foundrymen, "Synthetic Resins in the Foundry," FOUNDRY TRADE JOURNAL (July 5, 1951).

Pig-iron and Steel Production

Statistical Summary of May Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table I summarises activities during the previous six months. Table II gives production of steel ingots and castings in May, and Table III, deliveries of finished steel. Table IV gives the production of pig-iron and ferro-alloys in May and number of furnaces in blast. All figures in thousands of tons.

TABLE I.—*General Summary of Pig-iron and Steel Production.*

Period.	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy). Imports.[2]	Output of ingots and castings.	Deliveries of finished steel.	Stocks.[3]
1950	249	174	197	185	197	9	313	241	997
1951	282	170	206	186	175	8	301	243	589
1951—November	280	192	215	196	182	13	316	253	568
December	278	189	216	198	159	10	288	234	589
1952—January[1]	293	190	222	199	164	13	293	243	540
February	302	187	222	197	177	20	313	236	525
March	303	184	221	202	181	23	320	253	551
April[1]	302	184	224	201	171	29	305	248	576
May	322	183	231	201	174	45	312	264	585

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in May*, 1952.

District.	Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total. Ingots.	Total. Castings.	Total ingots and castings.
Derby, Leics., Notts., Northants and Essex	—	3.6	11.1 (basic)	1.6	0.2	15.6	0.9	16.5
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire	1.5	21.3	—	1.8	0.6	24.0	1.2	25.2
Yorkshire (excl. N.E. Coast and Sheffield)	—	29.3	—	—	0.1	29.2	0.2	29.4
Lincolnshire	1.7	59.9	—	1.2	0.5	61.4	1.9	63.3
North-East Coast	4.6	34.4	—	1.6	0.8	39.2	2.2	41.4
Scotland	—	15.2	—	0.9	0.9	15.2	1.8	17.0
Staffs., Shrops., Worcs. and Warwick	7.3	53.0	5.3 (basic)	1.1	0.1	66.2	0.6	66.8
South Wales and Monmouthshire	9.5	25.6	—	9.6	0.6	43.0	2.3	45.3
Sheffield (incl. small quantity in Manchester)	0.1	2.0	4.9 (acid)	0.4	0.1	7.3	0.2	7.5
North-West Coast	24.7	244.3	21.3	18.2	3.9	301.1	11.3	312.4
Total								
April, 1952[1]	23.7	239.9	20.9	16.9	3.7	294.7	10.4	305.1
May, 1951[1]	21.8	243.0	21.4	15.4	3.5	295.9	9.2	305.1

TABLE III.—*Weekly Average Deliveries of Finished Steel.*

Product.	1950.	1951.	1951. May.[1]	1952. April.[1]	1952. May.
Non-alloy steel:					
Ingots, blooms, billets and slabs[4]	3.6	4.0	3.9	4.5	5.4
Heavy rails, sleepers, etc.	11.3	10.1	11.1	10.1	10.1
Plates ¼ in. thick and over	40.0	41.0	41.4	41.8	42.6
Other heavy prod.	40.2	39.9	41.4	39.6	40.7
Light rolled prod.	47.6	47.1	48.0	45.2	46.9
Hot-rolled strip	19.4	19.5	18.9	18.3	19.5
Wire rods	16.3	16.1	16.8	15.1	16.6
Cold-rolled strip	5.5	6.0	5.6	6.1	6.6
Bright steel bars	6.3	6.6	6.6	6.0	6.6
Sheets, coated and uncoated	30.5	33.5	32.5	36.0	38.6
Tin, terne and blackplate	14.3	13.9	13.7	16.3	16.6
Tubes, pipes and fittings	20.0	22.0	20.5	23.5	26.2
Mild wire	12.5	11.9	11.7	12.7	14.2
Hard wire	3.5	3.7	3.6	3.2	4.2
Tyres, wheels and axles	3.5	3.7	3.1	3.7	3.7
Steel forgings (excl. drop forgings)	2.2	2.3	2.2	2.7	3.1
Steel castings	3.5	3.8	3.6	4.3	4.3
Tool and magnet steel	[7]	[7]	[7]	0.5	0.6
Total	280.2	285.1	284.6	289.6	306.5
Alloy steel	10.6	12.3	11.7	14.0	16.4
Total deliveries from U.K. prod.[5]	290.8	297.4	296.3	303.6	322.9
Add: Imported finished steel	3.8	4.9	3.0	12.0	15.4
	294.6	302.3	299.3	315.6	338.3
Deduct: Intra-industry conversion[6]	55.6	61.5	57.4	70.1	76.3
Total net deliveries	239.0	240.8	241.9	245.5	262.0

TABLE IV.—*Weekly Average Production of Pig-iron and Ferro-alloys during May*, 1952.

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants, and Essex	24	0.3	17.4	23.8	1.6	—	43.1
Lancs. (excl. N.W. Coast), Denbigh, Flints, and Cheshire; Yorkshire (incl. Sheffield, excl. N.E. Coast)	6	—	8.6	—	—	0.9	9.5
Lincolnshire	13	—	27.7	—	—	—	27.7
North-East Coast	24	5.9	40.2	0.4	—	0.8	47.4
Scotland	9	0.8	13.1	3.5	—	—	17.4
Staffs., Shrops., Worcs., and Warwick	9	—	9.2	1.6	—	—	10.8
S. Wales and Monmouthshire	8	3.0	24.4	—	—	—	27.4
North-West Coast	8	16.6	—	0.1	—	1.1	17.8
Total	101	26.6	140.6	29.4	1.6	2.8	201.1[8]
April, 1952[1]	100	27.4	142.1	28.3	1.0	2.6	201.4
May, 1951[1]	99	24.3	125.8	26.7	1.7	3.7	182.3[8]

[1] Five weeks, all tables.

[2] Weekly average of calendar month.

[3] Stocks at the end of the years and months shown.

[4] Other than for conversion into any form of finished steel listed above.

[5] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.

[6] *i.e.*, Material for conversion into other products also listed above.

[7] Included with alloy steel.

[8] Includes 100 tons direct castings.

Personal

MR. JOSEPH NASH, of Burton Terrace, Uttoxeter, has retired from Bamfords, Limited, Uttoxeter, after 54 yrs.' service. His fellow foremen gave him an eight-day clock.

MR. G. H. CLUBLEY has relinquished his post as works manager to Jarrow Metal Industries, Limited, upon his appointment as assistant general manager to E. Jopling & Sons, Sunderland.

SIR JOHN MAUD, Permanent Secretary to the Ministry of Education since 1945, has been appointed Permanent Secretary to the Ministry of Fuel and Power in place of SIR DONALD FERGUSSON, who retires at the end of next month.

MR. THOMAS CROMBIE, foreman moulder until two yrs. ago, until failing health enforced him to take over less exacting duties as pattern controller, has retired after 40 yrs.' service with the North British Steel Foundry, Bathgate. He was presented with a gold pocket watch from directors and staff.

THE RETIREMENT is announced of MR. REG. SHERWOOD, who has spent 49 years with John Harper & Company, Limited, much of it in the patternshop, rising from apprentice to foreman and subsequently on estimating and layout work. He was the recipient of gifts from the company and his colleagues at a recently-held ceremony.

TWO NEW APPOINTMENTS—director and controller—have been created by the Shipbuilding Conference. The offices of chairman and deputy chairman are being discontinued. The director will be MR. REX B. SHEPHEARD, hitherto chief ship surveyor of Lloyd's Register of Shipping, who will take up his duties as from the beginning of October.

SIR PETER BENNETT, M.P. for the Edgbaston division of Birmingham, has been reappointed joint managing director of Joseph Lucas (Industries), Limited. Sir Peter resigned from the board, of which he was also chairman, and from the board of Imperial Chemical Industries, Limited, in November of last year upon his appointment as Parliamentary Secretary to the Ministry of Labour.

MR. IVOR LLOYD, a director of Vab Products, Limited, brassfounders, of London, W.C.2, has been appointed chairman of the company in succession to MR. J. E. HODGKIN, who has relinquished that position. Mr. Lloyd is a joint managing director of Expert Tool & Case Hardening Company, Limited, London, S.W.1, and chairman and managing director of British Switchgear Corporation, Limited, London, S.W.19. Mr. Hodgkin is chairman of Darlington Wire Mills, Limited, and a director of several other companies. MR. R. ERIC KAY, the secretary of the company, has been appointed a director of Vab Products, Limited.

MR. D. B. COLLETT, vice-president and general manager of the Dunlop Tire & Rubber Goods Company, Toronto, is returning to England to join the main board of the Dunlop Rubber Company, Limited, as an executive director. He will work in close association with MR. A. HEALEY, the executive director in charge of all production including technical development, research, and labour policy. MR. J. P. ANDERSON, the company's chief purchasing agent, succeeds Mr. Collett as vice-president and general manager of the Dunlop Tire & Rubber Goods Company, Toronto. He will take up his appointment in the autumn. Mr. L. J. W. BAILEY, general manager of Dunlop Plantations, has been appointed chief purchasing agent of the Dunlop Rubber Company in succession to Mr. Anderson.

New Non-ferrous Metals Order

An Order (the Copper, Zinc, etc., Prices (No. 4) Order, 1952 (Si, No. 1462)), has been made by the Ministry of Supply reducing the prices of secondary copper, brass, copper scrap, gilding metal scrap, brass scrap, and cupro-nickel scrap, to take account of the recent reduction in the Ministry of Materials' selling price of virgin copper. The Order came into force on August 7.

The new prices are as follow:—

SECONDARY COPPER (increase of £2 per ton): Ingot bars or wire bars, (*a*) electrolytic, £285 10s.; (*b*) fire refined, (1) equivalent to HC, £285 10s.; (2) min. 99.88% copper, £285; (3) min. 99.70%, £284 10s.; (4) min. 99.5%, £284; (*c*) other than (*a*) or (*b*) above, £245; cathodes, £284 10s.; other, £245.

BRASS (increase of £1 per ton): (1) To B.S.S. No. 218 or No. 249, (*a*) cropped billets, £233; (*b*) uncropped billets, £231; (*c*) ingot, £288; (*d*) other than (*a*) to (*c*), £288; (2) 65/35 casting quality; ingot, £232; other than ingot, £232; (3) 70/30 casting quality (min. 68% copper): ingot, £242; other than ingot, £242; (4) 63/37 strip ingot for rolling, £242; (5) 70/30 strip ingot for rolling, £253; other than (1) to (5) above, in proportion.

COPPER SCRAP (increased by £2 per ton): Clean bright untinned or tinned wire, commutator bar, £255; fire box cut to crucible size, £255; fire box not cut, £250; No. 1 wire, £245; clean heavy, £240; No. 2 wire, £235; braziery, £213; other, in proportion.

CUPRO-NICKEL SCRAP: 70/30 process scrap, £282 (increased by £1 per ton); 70/30 used condenser tubes, £242 (increased by £1); 80/20 process scrap, £265 (increased by £2); other, in proportion.

GILDING METAL SCRAP (in any form): £240 (increased by £2 per ton).

BRASS SCRAP (increased by £1 per ton): QF cases free from primers, £215; QF cases not free from primers, £209; SAA cases mechanically treated or fired, £205; SAA cases muffled or furnaced, £199; cuttings, £202; rod and fuze scrap not burned, £187; swarf, £177; heavy, £172; other, in proportion.

Exports of Copper, Aluminium, and Iron and Steel Goods

Existing Open General Licences permitting the export of certain metal goods have been revoked and new licences issued with effect from Monday. These new licences, announced by the Board of Trade, make the following changes:—(i) Tibet is excluded from the countries to which the Open General Licences apply; (ii) the minimum value per ton of copper goods covered by the Open General Licence has been reduced from £700 to £500, and that for copper alloy from £600 to £420.

The goods concerned are those specified in Group 6(2) of the First Schedule to the Export of Goods (Control) (Consolidation) Order, 1952, and are:—Aluminium goods provided that the value exceeds the value of the aluminium or aluminium alloy content therein, calculated at the rate of £220 per ton; copper goods (other than cables and wires) provided that the value exceeds the value of the copper or copper alloy content therein, calculated at the rate of £500 per ton for copper, and £420 per ton for alloys mainly of copper; copper cables and wires provided that the value exceeds the value of the copper or copper alloy content therein, calculated at the rate of £400 per ton; iron and steel provided that the value exceeds the value of the iron and steel content therein, calculated at the rate of £40 per ton.

A NINE-DAY SCRAP METAL DRIVE is to be held in Lincoln in September. The campaign which is being organized by the City Council and the Joint Scrap Survey Committee will be the city's first big scrap drive since the war.

Iron and Steel Institute to Visit South Wales

As already announced in these columns, the Iron and Steel Institute has accepted an invitation from the Mayor of Swansea to hold a special meeting in Swansea from October 7 to 9. Further details of the visit are now available. A reception committee has been formed under the chairmanship of Colonel J. M. Bevan, to make the arrangements in South Wales. Sir Lewis Jones, South Wales Siemens Steel Association, and Mr. P. O. Williams, Welsh Plate and Sheet Manufacturers' Association, have agreed to act as honorary secretaries. It will be necessary to limit the total number of members and ladies requiring hotel accommodation to a maximum of 450.

Programme

On Tuesday, October 7, at the invitation of the chairman, Mr. E. H. Lever, and of the board of the Steel Company of Wales, Limited, members and ladies will be able to visit the Trostre works of the Tinplate Division of the Steel Company of Wales, Limited. The chief guest will be Mr. Duncan Sandys, Minister of Supply. A reception and buffet will be held in the evening in the Brangwyn Hall, Swansea, given by the Mayor of Swansea.

On the following morning, members may visit the Margam works to see the coke ovens, blast furnaces, and steelworks. In the afternoon, there will be a visit to the Abbey works to see the new steelworks and strip mills. A banquet and dance will take place in the evening at the Brangwyn Hall, Swansea.

The following works may be visited on October 9, the works being in Swansea except where otherwise stated:—Aluminium Wire & Cable Company, Limited, Port Tennant; British Iron and Steel Research Association, Sketty Hall; Imperial Chemical Industries, Limited, Waunarlwydd, and University College of Swansea; Metal Box Company, Limited, Neath, Glam.; Mond Nickel Company, Limited, Clydach; National Oil Refineries, Limited, Llandarcy Works, Skewen, Neath; National Smelting Company, Limited, Llansamlet; Steel Company of Wales, Limited, King's Dock.

It should be noted that the Steel Company of Wales, Limited, has issued an open invitation to the members of the institute and their ladies to visit the works at Trostre on October 7, whether they are taking part in the institute's meeting or not. The company will not be issuing separate invitations to anyone resident in South Wales or elsewhere who is a member of the Iron and Steel Institute whether or not they are directors or others employed by the Steel Company of Wales, Limited. Subject to sufficient numbers wishing to travel, a special train will be arranged from London and back to London on October 7.

Pay Increases in First Half-year

The number of workers in industries covered by the statistics of the Ministry of Labour who received wage increases in the first half of the year totalled 4,959,000. During that period their weekly wages rose by £1,971,000. In the corresponding period of last year 7,188,000 workers received £2,883,500. There were no decreases in wage rates during the 1952 period.

In the mining and quarrying group, 51,000 workers shared a weekly increase in wages of £18,800, while in the metals, engineering, and vehicles group, wages were increased by £273,300 for 731,000 workpeople.

Iron and Steel Industry

History of Public Control

At the time when the Government has newly set-out in a White Paper its proposals for the future conduct of the iron and steel industry, it is germane to recall that the iron and steel industry first came under public supervision in 1932. The Import Duties Advisory Committee (I.D.A.C.) was set up in that year to implement the Government's policy of tariff protection for industry in general, and gave special attention to the iron and steel industry, which at that time was being seriously weakened by the dumping of foreign supplies in the United Kingdom market. At the instigation of this committee, the industry was substantially reorganized and the British Iron and Steel Federation was set up, which thereafter co-ordinated and scrutinized the industry's development plans and prices.

In 1937 I.D.A.C. reported:—"Not the least important of the developments which have taken place is the acceptance both by the industry and, so far as we are able to judge, by public opinion, of a general oversight of the policy of the industry by an independent body looking to the public interest in its widest sense."

The war necessitated a much more detailed supervision and control of the industry, which was operated by the Iron and Steel Control of the Ministry of Supply.

In 1946, the Labour Government announced its intention to introduce a large measure of public ownership into the industry. Pending the introduction of legislation for this purpose, an advisory Iron and Steel Board was set up to consider plans for the development and modernization of the industry, to exercise general supervision over production, to administer iron and steel controls on behalf of the Government, and to advise on prices. This advisory board came to an end in March, 1949.

The Iron and Steel Bill was introduced in October, 1948, and became law in November, 1949. On the vesting date in February, 1951, the ownership of 92 companies, including the major basic producers, was transferred to the Iron and Steel Corporation of Great Britain, together with some 150 associated companies. Over 400 other steel-producing companies and most of the iron-foundries were left in private ownership.

Northern Ireland Trade in 1951

Northern Ireland trade in 1951, exclusive of parcel post, was estimated at £478,500,000, an increase of approximately £75,000,000, or about 19 per cent., compared with the corresponding total for 1950. The 1951 figure was the highest yet recorded, being £126,000,000 higher than the 1949 total and almost twice that of 1946. The excess of imports over exports in 1951 was £44,396,000, an increase of almost £7,000,000 over the excess in 1950.

Total imports into Northern Ireland in 1951 were estimated at £261,500,000, against £220,300,000 in 1950. Exports amounted to £217,000,000, an increase of £34,000,000 on 1950 exports, representing an increase of about 19 per cent.

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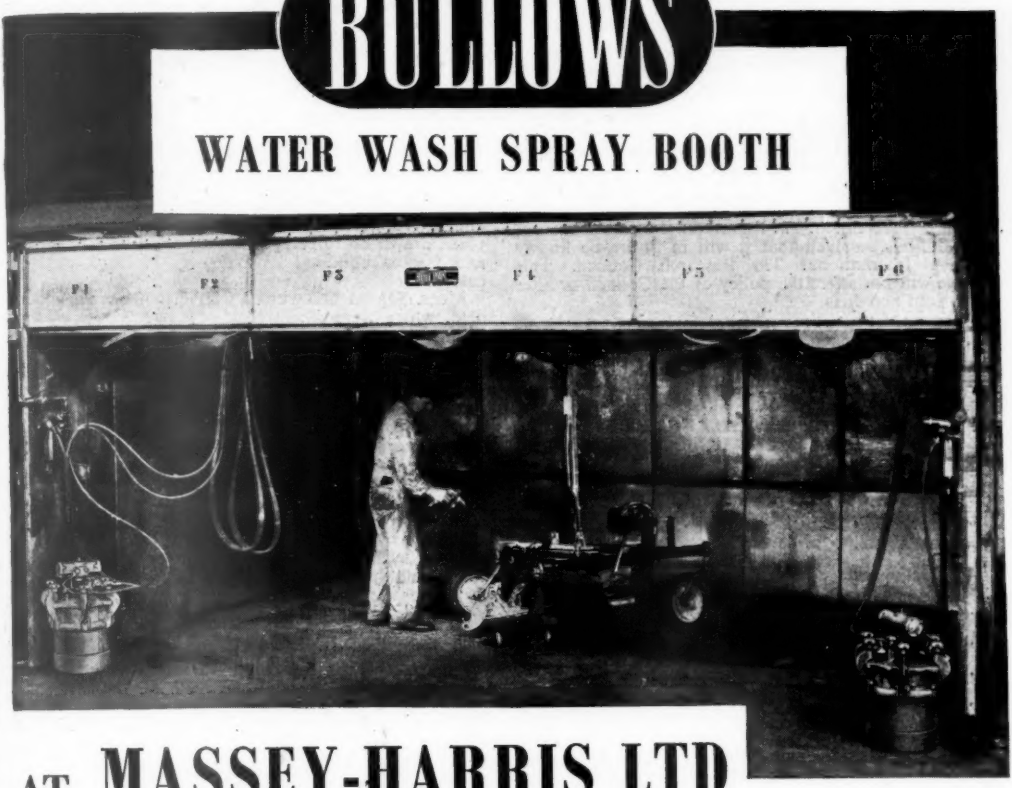

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News in Brief

THE LONDON SALES OFFICE of Britannia Batteries, Limited, has been transferred to new premises at 53, Victoria Street, S.W.1 (telephone: ABBey 6168-9).

MILLSPAUGH, LIMITED, SHEFFIELD, has obtained Canadian contracts for paper-making machinery worth over $1,000,000 in the face of keen American competition.

ELCONTROL LIMITED, who specialize in industrial electronic control equipment, have just moved into larger premises at Wilbury Way, Hitchin. Sales Headquarters, however, remain at 10 Wyndham Place, London, W.1.

THE INTERNATIONAL TIN RESEARCH AND DEVELOPMENT COUNCIL has resolved that it will in future be known as The International Tin Research Council. This change will not affect the policy of the Council or alter its current activities.

JONES & ATTWOOD, LIMITED, of Stourbridge, Worcestershire, have acquired the sole manufacturing and selling rights for the well-known range of two-, three- and six-ton bench power presses from the Mining Engineering Company, Limited, Worcester.

LEOPOLD LAZARUS, LIMITED, Creechurch House, Creechurch Lane, London, E.C.3, have been appointed U.K. and Northern Ireland agents for the Vereinigte Osterreichesche Eisen und Stahlwerk A.G. of Austria, for the sale of their pig-iron and rolled-steel products.

MOLINEUX FOUNDRY EQUIPMENT, LIMITED, of Marlborough Works, Marlborough Road, London, N.19, has acquired the sole manufacturing and sales rights of the K. & L. fettling bench. This has been described in a Paper to the Institute of British Foundrymen by Mr. Ottignon.

A NEW 100-FT. HIGH STEEL CHIMNEY, weighing 33 tons, was erected at the River Don Works of the English Steel Corporation, Limited, Sheffield, recently. Before the chimney, which is 15 ft. in diameter at the base, can be brought into use, 10,000 firebricks and 27,000 red bricks have to be laid.

DURING THE NIGHT of July 26, after employees of John Taylor & Company, bellfounders, Loughborough, had taken down for recasting the peal of eight bells belonging to the church of St. Francis of Assissi, Holbeck, Leeds, the smallest bell, weighing some 2½ cwt., was stolen from the churchyard.

OFFICIALS of the Staveley Iron & Chemical Company opened the first completed sections of their new sports ground at Barrow Hill, recently. Among those present were Mr. T. A. McKenna (chairman), Mr. S. W. Martin (managing director) and Mr. S. N. Turner (deputy managing director and chairman of the Sports Club).

THE PRICE OF CEMENT packed in paper bags has been reduced by 2s. 9d. per ton as from August 5. Cement delivered in bulk or in returnable packages is not affected. There was a general price reduction of 3s. a ton in June in the greater part of England and Wales and Northern Ireland, and by 2s. a ton in the remaining areas of England and Wales and in Scotland.

SEVERAL HUNDRED EMPLOYEES who will start production at the new Rolls-Royce factory in the new town of East Kilbride, near Glasgow, early next month, are already engaged in aero-engine work. They are now employed in the work at the expanding Hillington plant so that when the transfer starts—probably at the end of this month—they will move as an operating unit. The new factory will help in the production of the Avon jet engine.

THE BRITISH EXPORT TRADE RESEARCH ORGANIZATION (1952) has been formed as a company limited by guarantee without share capital. Management is vested in a council, the first members of which include Mr. Leslie Gamage, vice-chairman of the General Electric Company, Limited, and Mr. Roger Falk, who was director of the old B.E.T.R.O. The new organization has been formed to keep the name of the old body alive and to use the money remaining from it.

HEMEL HEMPSTEAD ENGINEERING COMPANY, LIMITED, are seeking permission to extend the foundry at Hemel Hempstead, Herts. ROBERT HYDE & SONS, LIMITED, propose the erection of a new staff canteen, research offices, laboratory and other buildings at their steel foundry in High Street West, Fenton, Stoke-on-Trent; and INTERNATIONAL HARVESTERS, LIMITED, have had plans drawn up to carry out extensions to the foundry and tractor buildings at Wheatley Hall Road, Doncaster.

MOLL SPRING DYEWORKS, Netherton, near Huddersfield, which were recently closed after being operated by the Oldham family for nearly a century, was sold by auction on July 30 to David Brown Tractors, Limited, Meltham, for £3,000. Included in the sale are a four-storey mill, motive plant, three reservoirs, about 19 acres of land, a quarry, and three houses, with the occupied parts of the premises yielding rentals of £343 a year. An official of the firm said that the premises would be used for general storage.

ESTON URBAN DISTRICT COUNCIL planning committee has given formal approval to an outline plan submitted by Dorman, Long & Company, Limited, for the erection of two new blast furnaces and a 315-ft. high gas holder at the Cleveland works of the company. It was stated that in addition to extensive alterations to the rail, road, gas and water facilities within the works, the scheme called for the closing of a public road and, subject to the provision of an alternative access road, the committee also gave their assent to this part of the scheme.

THE COMMERCIAL DEPARTMENT of the British Embassy in Athens reports that Industria S.A., Industrial and Technical Installations, 9, Clisthenis Street, Athens, wishes ot act as agents for U.K. manufacturers of plant for the food industry, for making metal containers, and for edible oil refining. Makers who are interested should communicate with Industria S.A. at the above address, at the same time notifying the Board of Trade, Commercial Relations and Exports Department, Horse Guards Avenue, London, S.W.1. (reference, C.R.E./20711/52), of any action taken.

A 20,000-DOLLAR steel casting, weighing 80 tons, and believed to be the biggest-ever exported from this country, last Friday began its journey by special lorry from the Sheffield works of the English Steel Corporation, Limited, to the Manchester Ship Canal for shipment to Montreal on the ss. Manchester Trader. The transport to Manchester will take several days on account of the size of the casting, and when unloaded there it will be the heaviest lift ever undertaken at that port. The casting is to form one of the main components of a 7,000-ton forging press.

SHEFFIELD STEEL AND ENGINEERING WORKS were visited recently by technical college teachers from all parts of the country, as part of a refresher course arranged by the Ministry of Education. The party of 60, all teachers of management and commercial subjects, split up to visit the Stocksbridge works of Samuel Fox & Company, Limited, steel manufacturers, the works of the Laycock Engineering Company, Limited, and the Darnall works of the Davy & United Engineering Company, Limited, where they saw a 12-ft. long three-dimensional model of a new £2,000,000 continuous steel rolling mill, being built for the Consett Iron Company, Limited, Consett (Co. Durham).

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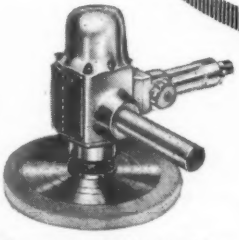
This self-contained power unit fits perfectly into every tool in the range, and is readily removed intact. Its cylinder walls are of hard chrome plate.



SERIES 41 ROTOSANDERS— Surface grinders and sanders ideal for large area work. Same interchangeable motor as in Series 4000 Rotodrills. Thumb-type throttle gives perfect control.

SERIES 40 ROTOGRINDS — Useful range of general-purpose grinders, surface grinders, loco rod and extension grinders. Various speeds for all classes of work. Straight or grip handles supplied. Features similar to Series 4000 Rotodrills.

SERIES 4000 SCREW FEED ROTODRILLS — Reversible and non-reversible types. Smooth casing for easy handling. Automatic safety device and lubrication. Instantaneous reversing — wide gearing range. All usual capacities available.

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SUBSIDIARY COMPANIES, BRANCHES AND AGENCIES THROUGHOUT THE WORLD. HC10

Raw Material Markets

Iron and Steel

With many foundries still idle because of holidays, the level of production in the industry is, of course, reduced. On the whole, the demand for castings is maintained, although the foundries catering for the textile trades and those producing light castings, for which there is a slight decline, are less happily situated. With these exceptions, however, the prospects of the trade are good and will be better when there is a renewal of export business.

The substantial increase in pig-iron production suggests that foundries can expect to receive larger supplies. It is a long time now since production of the foundry grades of pig-iron was equal to the demand, while it is even longer since consumers were able to amass stocks. Very large tonnages are required to remedy this position. The position is most difficult in the low- and medium-phosphorus grades and hematite for the engineering and speciality foundries. Although it is gratifying to know that pig-iron production is expanding steadily, practically the whole of the additional quantity forthcoming is, of necessity, destined to go to the steelworks, with scarcely any increase in the foundry grades.

As far as foundry coke is concerned, the situation shows little variation from week to week. Current needs are covered, but users are still unable to make provision for the future and the position will remain somewhat precarious until it is possible to accumulate stocks.

The re-rollers have more material on hand now than they have had for some time, but they are still short of the smaller sized billets. The improvement is due to increased deliveries from the Continent and it is understood that Continental supplies will expand still more in the last period of the year, while, with the settlement of the strike of American steelworkers, it is hoped that the full tonnage of steel semis promised from the United States will now be forthcoming. A continuance of deliveries from abroad is essential, home steelworks being unable to increase appreciably their allocations of prime material and arisings of defectives, crops, etc., are meagre. The re-rollers are now in a better position to work off some of their long-standing commitments for the smaller sizes of sections, bars, and strip, much of which are urgently required for export and priority orders at home.

The sheet re-rollers have also shared in the improved supplies of steel, but they have sufficient work on hand to warrant much increased supplies of sheet bars and slabs.

Non-ferrous Metals

Last Friday saw a sharp drop in zinc to £118 per ton, the reduction of £12 being the equivalent of a 1½ cents cut in the U.S. price of the metal. This had been foreshadowed by a split price when some producers still remained at 15 cents, but within 24 hours the market had levelled out at 13½ cents, which is equal to about £108 per ton. On Tuesday the U.K. price advanced by £4 to £122 per ton, the U.S. price moving up on the same day to 14 cents. Sentiment seems to be rather bearish about zinc, for production is rising and demand does not appear to be particularly good. These changes in zinc mean that the revised schedule of scrap prices published a week ago must be again adjusted in respect of brass and gilding metal. Selling prices for brass semis were quickly altered to match the decline, but consumers seem to be somewhat shy of buying at present. In fact, there has been a noticeable lull in business since Bank holiday, and buyers are certainly not disposed to do more than cover on a hand-to-mouth basis.

Tin has displayed a firmer tone this week. At one time last week it looked as if the price would break £900, for down to £910 was accepted on the kerb market, but at around that level buyers came in. However, now that the Government has secured the full 20,000 tons that it required for fulfilling the American commitment support is lacking from that quarter.

There is nothing fresh to report about lead, but it is hoped that, in accordance with the Ministry's wish, the market will be able to make a start on October 1. It is believed that the Metal Exchange is overhauling the machinery of marketing and that a revision of the lead contract is in progress. Doubtless, too, conversations are taking place between the committee and the Government departments concerned, for there are bound to be matters which require discussion and elucidation. For one thing the Ministry of Materials is holding large stocks of imported lead, the future of which has to be determined.

It is reported from New York that international allocation of copper will be continued through the fourth quarter, but there are indications that it may be freed for the first quarter of next year and thereafter. Nickel remains scarce, although supplies are slowly increasing.

London Metal Exchange official tin quotations:—

Cash—Thursday, £917 10s. to £920; Friday, £922 to £923; Monday, £932 to £933; Tuesday, £931 to £932; Wednesday, £934 to £935.

Three Months—Thursday, £918 to £920; Friday, £922 10s. to £923; Monday, £932 10s. to £933; Tuesday, £930 10s. to £931; Wednesday, £931 to £933.

New Standards

British Standards Institution Monthly Information Sheet for July, 1952, "New Standards Issued," lists:—1876:1952, Automatic flushing cisterns for urinals (2s.). Under "Revised Standards" there is B.S. 497:1952, Cast manhole covers, road gully-gratings and frames for drainage purposes (5s.). These manhole covers and road gully-gratings are classified as follows:—Manhole covers and frames: heavy-duty for carriage ways, medium-duty for footpaths, and light-duty for domestic premises or other places where they do not have to carry wheeled traffic. Gully-gratings and frames: heavy-duty for main roads, medium-duty for other roads not subject to heavy vehicles or fast traffic, and kerb-type for setting into footpaths and verges. Requirements are given for overall dimensions, materials, manufacture and workmanship, protective coatings, marking, and inspection. The articles are graded according to the duty they have to perform. A loading test is given appropriate to the class of duty, and all articles have to pass this test. Approximate weights of covers are given in an appendix for information only.

Finally, and under "Amendment Slips," there are:—PD 1417, Amendment No. 1 to B.S. 1400:1948, copper-alloy ingots and castings; PD 1422, Amendment No. 2 to B.S. 1575: 1949, cast-iron pipe flanges and flanged fittings, class 125, for the petroleum industry; PD 1423, Amendment No. 2 to B.S. 1576:1949, cast-iron pipe flanges and flanged fittings, class 250, for the petroleum industry; and PD 1426, Amendment No. 1 to B.S. 534:1934, steel spigot-and-socket pipes and specials for water, gas and sewage.

Future publications will include 1870:1952, Men's safety boots and shoes (2s. 6d.).

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FERRO ALLOY BRIQUETTES

are the modern and easy method of adding Ferro Alloys to cast iron

SILICON BRIQUETTES
(for softening hard pig iron and scrap)

Direct from manufacturer to your foundry

CHROMIUM BRIQUETTES
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SILICO-MANGANESE BRIQUETTES *(for scavenging and adding manganese to charges containing steel)* **FERRO-MANGANESE BRIQUETTES**

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F. & M. Briquettes are specially devised for use in Cupola melting of iron, and form one of the most useful means of softening, refining and adjusting the composition of cast iron. They are of special value in the manufacture of High Duty Cast Iron.

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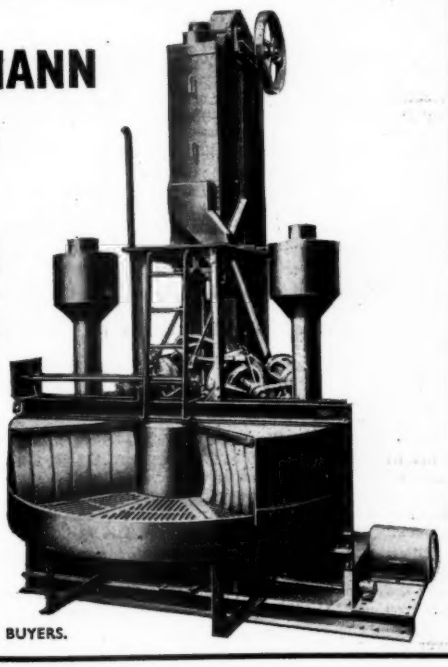
(Tel. : WATERLOOVILLE 2225).



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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered, unless otherwise stated)

August 13, 1952

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 1s. 6d.; Birmingham, £12 15s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £13 17s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent P, up to 3 per cent. S), d/d within 60 miles of Stafford, £15 5s. 9d.

Scotch Iron.—No. 3 foundry, £14 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £17 4s. 6d.; South Zone, £17 7s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £17 14s. 6d.; South Zone, £17 17s.

Cold Blast.—South Staffs, £18 7s.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £13 11s. 6d.; Scotland (Scotch iron), £13 18s.; Sheffield, £14 9s. 6d.; Birmingham, £14 17s. 6d.; Wales (Welsh iron), £13 18s.

Basic Pig-iron.—£12 10s. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45% Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75% Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 22s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204; ditto, copper-free, £212.

Ferro-tungsten.—80/85 per cent., 28s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 31s. 7d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60% Cr, scale 28s. 3d. per unit; 6/8 per cent. C, £80 17s., basis 60% Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr.: max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 6s. 9d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £43 15s. 2d.

Metallic Manganese.—93/95 per cent., carbon-free, £262 per ton.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 4s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £25 14s. 6d.; hard (0.42 to 0.60 per cent. C), £27 12s.; silico-manganese, £33 8s.; free-cutting, £28 8s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £31 9s.; case-hardening, £31 17s.; silico-manganese, £34 9s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 8s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 8s.; acid, up to 0.25 per cent. C, £31 17s.

Sheet and Tinplate Bars.—£25 3s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £29 14s.; boiler plates (N.-E. Coast), £31 1s. 6d.; chequer plates (N.-E. Coast), £31 3s.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £27 17s.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 15s. 6d.; flats, 5 in. wide and under, £31 15s. 6d.; hoop and strip, £32 10s. 6d.; black sheets, 17/20 g., £40 12s. 6d.; galvanized corrugated sheets, 17/20 g., £54 4s.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £50 18s. 3d.; nickel-chrome, £71 6s. 9d.; nickel-chrome-molybdenum, £78 14s.

Tinplates.—57s. 1½d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £285; high-grade fire-refined, £284 10s.; fire-refined of not less than 99.7 per cent., £284; ditto, 99.2 per cent., £283 10s.; black hot-rolled wire rods, £294 12s. 6d.

Tin.—Cash, £934 to £935; three months, £931 to £933; settlement, £934

Zinc.—G.O.B. (foreign) (duty paid), £122; ditto (domestic), £122; "Prime Western," £122; electrolytic, £126; not less than 99.99 per cent., £128.

Lead.—Good soft pig-lead (foreign) (duty paid), £131; ditto (Empire and domestic), £131; "English," £132 10s.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, — ; rolled zinc (boiler plates), all English destinations, — ; zinc oxide (Red Seal), d/d buyers' premises, — .

Other Metals.—Aluminium, ingots, £157; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £65; nickel, £454.

Brass.—Solid-drawn tubes, 27d. per lb.; rods, drawn, 37d.; sheets to 10 w.g., 31½d.; wire, 32¾d.; rolled metal, 29¾d.

Copper Tubes, etc.—Solid-drawn tubes, 32¾d. per lb.; wire, 317s. 9d. per cwt. basis; 20 s.w.g., 346s. 3d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £212 to £270; BS. 1400—LG3—1 (86/7/5/2), £235 to £280; BS. 1400—G1—1 (88/10/2), £352 to £400; Admiralty GM (88/10/2), virgin quality, £375 to £380 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £365 to £425; L.P.Bl, £290 to £335 per ton.

Phosphor Bronze.—Strip, 43¾d. per lb.; sheets to 10 w.g., 46d.; wire, 49½d.; rods, 44½d.; tubes, 42½d.; chill cast bars: solids 4s. 4d., cored 4s. 5d. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 2s. 9½d. per lb. (7%) to 3s. 10½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 3½d. (7%) to 4s. 4½d. (30%); to 12 in. wide × .056, 3s. 3½d. to 4s. 4½d.; to 25 in. wide × .056, 3s. 5½d. to 4s. 6½d. Spoon and fork metal, unsheared, 3s. 0½d. to 4s. 1½d. Wire, 10g., in coils, 3s. 9¾d. (10%) to 4s. 10½d. (30%). Special quality turning rod, 10%, 3s. 8¾d.; 15%, 4s. 1½d.; 18%, 4s. 6½d. All prices are net.

Obituary

THE DEATH took place recently of MR. JAMES RITCHIE PARK, a managing director of the British Oxygen Company, Limited, London, W.1.

MR. A. H. HOGGINS, who died recently at the age of 67, had been associated with Walsall Conduits, Limited, West Bromwich (Staffs), for 32 years. He had been a director since 1936 and before that was manager of the tube department. Widely known in Midland industrial circles, Mr. Hoggins was president of the West Bromwich, Smethwick and District Manufacturers' Association in 1939.

MR. MAURICE RATHBONE, who was a director of A. & R. Brown, Limited, shiprepairers and brassfounders, of Liverpool, Mersey Insulation Company, Limited, and other companies, died recently at the age of 67. He was a fellow of the Institute of Chartered Shipbrokers, and a corporate member of the Institute of Export, of which he was vice-chairman of the Liverpool branch in 1946 and chairman in 1947, subsequently serving on the local branch committee.

WITH A RECORD of 42 years' service with Firth-Vickers Stainless Steels, Limited, and its predecessors, MR. C. CYRIL HALL has died at the age of 56. He was a special director and liaison officer with the research department, and made important contributions to the development of corrosion and heat-resisting steels. He was a member of the Sheffield Metallurgical Association, and a past-chairman and past-president of the Sheffield branch of the Institute of Welding.

THE DEATH has taken place at the age of 91, of MR. CHARLES JAMES, who between 1906 and 1908 was associated with the development of the caterpillar tractor by Richard Hornsby, Limited, Grantham. Mr. James joined the works when he was 17, and when he retired in 1921 he was chief engineer and had spent 43 years with Richard Hornsby, Limited, and Ruston & Hornsby, Limited. The caterpillar tractor was invented by Mr. David Roberts, works manager and a director of the original firm, and Mr. James supervised its construction and saw it through all the trials until it was accepted by the War Office.

THE DEATH at 77 is announced of MR. FREDERICK LLOYD, managing director of Ibbotson Bros. & Company, Limited, and director of Woodhead Components, Limited, of Sheffield. He came to Sheffield over 40 yrs. ago, and started business as a tool manufacturer. He was a pioneer in the wireless world, and set up his own broadcasting station long before B.B.C. days. For his work in the scientific and radio fields he received the honorary degree of Master of Engineering from Sheffield University, and later he was made a member of the applied science committee of the University. Among his inventions are a low-temperature carbonizing retort for the production of smokeless fuel, and a motor fuel derived from coal. He also designed a cast-iron sectional bungalow. Mr. Lloyd was a City Councillor, Town Trustee, and, until his retirement in 1950, a J.P.

BRITISH - HELLENIC - DOUCAS BROS., 116, Syngrou Avenue, Athens, is anxious to obtain a U.K. agency for agricultural machinery, 30 hp. and 90/150 hp. Diesel wheel and crawler tractors, and harvesters. Interested makers should write to the company at the above address giving full particulars of their products, and at the same time notify the Board of Trade, Commercial Relations and Exports Department, Horse Guards Avenue, London, S.W.1 (reference, C.R.E./20711/52), of any action taken.

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PREPAID RATES: Twenty words for 5s. (minimum charge) and 2d. per word thereafter. Box Number, 2s. extra (including postage of replies).

Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, 49, Wellington Street, London, W.C.2. If received by first post Tuesday advertisements can normally be accommodated in the following Thursday's issue.

SITUATIONS WANTED

YOUNG METALLURGIST seeks progressive position, South Staffs. area. Seven years' experience laboratory, cupolas, oil furnaces. Chilled and High Duty Castings and Non-ferrous. H.N.C. and City and Guilds. Used to full control. Box 1974, FOUNDRY TRADE JOURNAL.

BRASSFOUNDRY, Plumbers and Engineers.—Gentleman, A.M.I.B.F., fully experienced in all modern phases, methods of production, and outlook, seeks situation as MANAGER or PRACTICAL ASSISTANT to Director. Wolverhampton or West Midlands preferred. Confidential.—Box 1981, FOUNDRY TRADE JOURNAL.

MANAGER, 45, (M.I.B.F. Dip.) Practical Foundryman. Sound technical training, desires change to a progressive company. Experience covers control of foundries producing heavy marine, diesel engine, machine tool and general engineering castings in green sand, dry sand and loam; also semi and fully mechanised foundries, grey and high duty irons. Meehanite metal and non-ferrous. Estimating, costing and sales. Accustomed to full control of foundries and patternshop to director level. Box 1973, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order 1952

YOUNG METALLURGIST, interested in prospects of future executive position, required by expanding Light Engineering and Metal Casting Company in W. London. Applicants should have L.I.M., H.N.C. or University Degree. Starting salary in region £550/£650.—Apply Box 1975, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN (35/45) required for Iron Foundry producing castings in grey and high duty iron up to three tons in weight. Machine moulding experience essential. Bristol area, modern house available. Applicants should state in confidence their complete experience, age, and salary required.—Box 1978, FOUNDRY TRADE JOURNAL.

NEWLY formed Research Organisation, with headquarters in Birmingham, requires the services of a TECHNICAL SECRETARY to co-ordinate its work. Although duties will be largely Secretarial and Administrative, applicants must have engineering and metallurgical qualifications in Iron and Steel. Position would be for a preliminary period of one year, but would be permanent if satisfactory results achieved. Salary according to experience and qualifications.—Apply to: "Research," PEAT, MARWICK, MITCHELL & Co., Lombard House, Great Charles Street, Birmingham, 3.

SITUATIONS VACANT—*Contd.*

CORE SHOP CHARGEHAND required for repetition Foundry in Midlands area.—Write, stating age, full experience, and salary required, Box 1960, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER required for large South Wales Foundry, specialising in non-ferrous metals. Applicants must have large experience in Manganese and Aluminium Bronze Castings up to 3 tons. State full particulars of experience and salary required.—Box 1958, FOUNDRY TRADE JOURNAL.

PATTERNMAKER, first-class, required by large Foundry—in Republic of Ireland—producing high quality domestic appliances. Must be experienced in Plaster, Lead and Tin and Wood pattern equipment for both machine and floor moulding. The position offers scope and variety, together with good salary, for keen man. House available for successful applicant.—Write in first instance, giving particulars of experience, etc., to Box 1968, FOUNDRY TRADE JOURNAL.

FOUNDRY SUPERINTENDENT wanted for Foundry near Smethwick, Staffs. Preferably used to high duty irons, but must possess drive, energy, and the ability to get things done. This is a permanent, progressive post for the right man. Applicants should state in confidence their complete experience, together with salary required.—Box 1970, FOUNDRY TRADE JOURNAL.

METALLURGIST required for Non-ferrous Foundry, including Aluminium. This is an excellent opportunity for an experienced man to secure a permanent and progressive post with a modern firm. Midlands area. State full details and salary required.—Box 1982, FOUNDRY TRADE JOURNAL.

FIRST-CLASS IRONFOUNDRY FOREMAN required for Mechanised Plant in a North-East Coast Foundry. Applicants must be keen, energetic, able to take control, and fully experienced in Cupola practice and sand control. The position is permanent for the right man.—Apply in first instance giving full details of qualifications, experience, etc., to Box 1983, FOUNDRY TRADE JOURNAL.

A LIAISON OFFICER is required for a heavy Engineering Company which uses a large variety of steel and iron castings. The successful applicant must be capable of making investigations and giving advice to the drawing office, which will (a) lead to the simplification of pattern construction and moulding procedure, and (b) obviate points in design which might cause unsoundness and defects.—Applications, stating age, experience and salary required, to be addressed to Box 1957, FOUNDRY TRADE JOURNAL.

DIPLOMA COURSE

ADVANCED TRAINING FOR THE FOUNDRY INDUSTRY.

THE NATIONAL FOUNDRY COLLEGE, which is financed by the Ministry of Education and fully supported by the Industry, prepares students for the many executive positions in the industry. Students who successfully complete the Course are awarded the National Foundry College Diploma, which is recognised as the premier award in Foundry Management and Science.

Applications are invited for admission to the two-year Diploma Course which opens on 22nd September, 1952. Sufficiently qualified candidates may enter directly in to the final year. The Prospectus of the College lists the necessary qualifications and other relevant information. Prospectuses and forms of application may be obtained, post-free, from the Head:—

NATIONAL FOUNDRY COLLEGE
Wulfruna Street, Wolverhampton, Staffs.

FINANCIAL

NON-FERROUS FOUNDRY, Kent, requires additional capital, £3/5,000. Established 5 years. Government contracts, £25,000. Potential capacity approx. 30 tons per month. Sand and Die Castings. Area approx. 9,000 sq. ft., with ample room for extension. Full details upon request.—Box 1977, FOUNDRY TRADE JOURNAL.

PATENT

THE Proprietors of Patent No. 546,104, for "Process and Apparatus for Reducing Divided Material such as Ores containing Solid Oxides with Reducing Gas," desire to secure commercial exploitation by licence or otherwise in the United Kingdom.—Replies to HASELTINE, LAKE & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

MACHINERY WANTED

WANTED.

FOUNDRY MACHINERY, every description, including Moulding Machines, Sand Mills and Mixers, Cupolas, Furnaces, Cranes; also Machine Tools, etc.

Temporary Office Address:
S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.,
8b, Birmingham Street, Oldbury, near Birmingham. Broadwell 1359.

WANTED.—Conveyor type Annealing Furnace, electrically heated, with cooling chamber, and for use with controlled atmosphere. Heating zone, 10 ft. 18 in. wide, approx. 4 in. high. Suitable for operating to 1,200 deg. C.—Box 1979, FOUNDRY TRADE JOURNAL.

WANTED URGENTLY.—600/760 c.f.m., 2-stage Air Compressor, 100 lb. pressure, motorised 400/3/50, with Air Receiver. Alley McLellan preferred.

GEORGE COHEN SONS & CO., LTD., Wood Lane, London, W.12.